# BUILDING ENERGY SIMULATION USER NEWS

**Volume 20 ❖ Number 1 ❖ Spring 1999**

**For Users of DOE-2, SPARK, BLAST and their Derivatives**


## What's New ?

❖ **EnergyPlus Update ...**

On May 7 in Chicago, the EnergyPlus team will hold a workshop for those interested in developing modules or user interfaces. Participants in the workshop will receive an executable copy of the current EnergyPlus pre-beta version plus detailed specifications for I/O and data structures. To attend the workshop, you must have executed a license agreement in advance. For more information on licensing and participating in the workshop, contact Dru Crawley at DOE Headquarters: Drury.Crawley@ee.doe.gov.

**First milestone:**
In early December, the EnergyPlus team reached its first milestone: an alpha version. This version (intended for internal testing) was demonstrated to more than 50 people at a workshop in late January.

**Next milestone:**
Beta test version expected late Spring 1999. We will announce the availability of beta versions of EnergyPlus here in the *User News* and on the Energy Plus web site at
**www.eren.doe.gov/buildings/energy_tools/energyplys.htm.**

❖ **SRG Website ... http://gundog.lbl.gov/**

Please check out our new website. In addition to the snazzy home page, there are links to technical reports, the *User News*, software, and up-to-date descriptions of our current research.

❖ **It was 20 Years Ago Today ...**

The SRG would like to thank all of the faithful users who have supported us over the years. As an anniversary present, we've added two new features to the *User News:*
On p. 20 there is a listing of "Special Versions of DOE-2" and on the back page there are sites where you may download LBNL-sponsored software....FREE!

***What's New?*** **is continued on p. 26**

## What's Inside ?

### *Features*


**2** EnergyPlus: A New-Generation Building Energy Simulation Program

**14** The "BLDG SIM" Mailing List

**14** Newsletter Deadlines

❦ Special 22-Page Insert:
**Revised and Updated "Weather Processor" section for the DOE-2 Reference Manual**


### *Departments*


**15** Recent Reports from LBNL
- ❖ Component-Based and Equation-Based Solvers for HVAC Simulation: A comparison of HVACSIM+ and SPARK
- ❖ Energy and Daylight Performance of Angular Selective Glazings

**26** Meetings, Conferences, Symposia


### *Reader Services*


**16** BLASTnews

**18** DOE-2 Directory of Software and Services

**20** Special Versions of DOE-2

**22** International DOE-2 Resource Centers

**23** International DOE-2 Energy Consultants

**23** DOE-2.1E Bug Fixes fia FTP

**24** U. S. DOE-2 Energy Consultants

**27** Weather Data Sources

**28** DOE-2 Documentation for International Users

**29** DOE-2 Documentation for Users in the U.S., Canada and Mexico

**29** Subscriptions, Help Desk, DOE-2 Training

**30** Download and Test LBNL Software



The *Building Energy Simulation User News* is published by the Simulation Research Group at Lawrence Berkeley National Laboratory with cooperation from the Building Systems Laboratory at the University of Illinois. Direct comments or submissions to Kathy Ellington, MS: 90-3147, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, or email kathy@srge.lbl.gov or fax us at (510) 486-4089. Direct BLAST-related inquiries to the Building Systems Laboratory, phone (217) 333-3977 or email support@blast.bso.uiuc.edu ☺ ☺ ☺ ☺ 04/99 2000 © 1998 Regents of the University of California, Lawrence Berkeley National Laboratory. This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technology, State and Community Programs, Office of Building Systems of the U.S. Department of Energy, under Contract No. DE-AC03-76SF00098. Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, University of California, Berkeley, CA 94720 USA ¦

**Proceedings of**
**Renewable and Advanced Energy Systems for the 21st Century**
**April 11-15, 1999, Lahaina, Maui, Hawaii**

# EnergyPlus: A New-Generation Building Energy Simulation Program

Drury B. Crawley
U.S. Department of Energy
Washington, DC

Linda K. Lawrie
U.S. Army Construction Engineering Research Laboratories
Champaign, Illinois

Curtis O. Pedersen, Richard J. Liesen, Daniel E. Fisher,
Richard K. Strand, and Russell D. Taylor
University of Illinois at Urbana-Champaign
Urbana, Illinois

Frederick C. Winkelmann, W. F. Buhl,
Y. Joe Huang, and A. Ender Erdem
Lawrence Berkeley National Laboratory
Berkeley, California

**ABSTRACT**
Many of the popular building energy simulation programs around the world are reaching maturity –some use simulation methods (and even code) that originated in the 1960s. For more than two decades, the U.S. government supported development of two hourly building energy simulation programs, BLAST and DOE–2. Designed in the days of mainframe computers, expanding their capabilities further has become difficult, time-consuming, and expensive. At the same time, the 30 years have seen significant advances in analysis and computational methods and power—providing an opportunity for significant improvement in these tools.

In early 1996, a Federal agency began developing a new building energy simulation tool, EnergyPlus, building on development experience with DOE–2 and BLAST. EnergyPlus includes a number of innovative simulation features—such as variable time steps, built-in template and external modular systems that are integrated with a heat balance-based zone simulation—and input and output data structures tailored to facilitate third party module and interface development. Other planned simulation capabilities include multi-zone airflow, and electric power and solar thermal and photovoltaic simulation. Beta testing of EnergyPlus begins in mid 1999.

## INTRODUCTION

For the past 20 years, the U.S. government supported development of DOE–2 and BLAST. BLAST [BLA 92], sponsored by the U.S. Department of Defense (DOD), has its origins in the NBSLD program developed at the U.S. National Bureau of Standards (now NIST) in the early 1970s. DOE–2 [WIN 93], sponsored by the U.S. Department of Energy (DOE), has its origins in the Post Office program written in the late 1960s for the U.S. Post Office. The main difference between the programs is the load calculation method—DOE–2 uses a room weighting factor approach while BLAST uses a heat balance approach. Both programs are widely used throughout the world.

Each program comprises hundreds of subroutines working together to simulate heat and mass energy flows throughout a building. In some cases, subroutines in DOE–2 were more accurate. In other cases, subroutines in BLAST were more accurate. In both programs, however, simulation methodologies (or loops) are often difficult to trace due to decades of development (and multiple authors). Often, this results in "spaghetti code" with data and subroutines for a particular simulation capability spread throughout the program. To modify either program, a developer must have many years of experience working within the code, knowledge of code unrelated to their task (because of the spaghetti), and (for sponsors) an extraordinary investment of time and money.

Why the U. S. government supported two separate (and comparable capability) programs has been questioned for many years. Discussions on merging the two programs began in earnest in 1994 with a DOD-sponsored workshop in Illinois. Nothing concrete resulted from that workshop, but eventually, DOE took the initiative and began developing a new program, named EnergyPlus, in 1996. The EnergyPlus team includes U. S. Army Construction Engineering Research Laboratories (CERL), University of Illinois (UI), Lawrence Berkeley National Laboratory (LBNL), and DOE. In this paper, we present an overview of the organization and capabilities of EnergyPlus and explain the rationale and structure behind the overall program.

### Why a New Program?

As mentioned earlier, DOE–2 and BLAST have become expensive to maintain, modify and enhance, because of 20+ year-old code and old Fortran structures (or general lack of structure). When DOD ended support for BLAST in 1995 due to budget

constraints, we took the opportunity to combine the resources, teams, and best capabilities and features of BLAST and DOE–2. The last version of BLAST was released in spring 1998 and the last version of DOE–2 with contributions under DOE-sponsorship was completed in 1998. Initially, we thought that we could create a "best of" program—combining modules from the two programs—without starting from scratch. After initial development work, we determined that EnergyPlus would cost less to develop, be released faster, and be easier to modify and extend if we wrote all new, modular, structured code. Thus, EnergyPlus is all-new Fortran 90 code.

**What is EnergyPlus?**

EnergyPlus is a new building performance simulation program that combines the best capabilities and features from BLAST and DOE–2 along with new capabilities. EnergyPlus comprises completely new code written in Fortran 90. It is primarily a simulation engine—there is no interface. Input and output are simple comma-separated, ASCII text files, a much simpler input structure than either DOE–2 or BLAST. Both BLAST and DOE–2 have been successful in attracting third-party developers for user interfaces and new modules. We have invited these same developers to participate in EnergyPlus beginning during beta testing—to work on new simulation modules or user interfaces.

**Modular Code**

One of the main goals for the EnergyPlus development effort has been to create a well-organized, modular structure that facilitates adding features and links to other programs. In evaluating programming languages, we found we had two choices—move to C/C++ or stay with Fortran. Despite the advantages of the structure and object-orientation of C/C++, we decided to select Fortran 90 as the programming language for EnergyPlus because Fortran 90:

- is a modern, modular language with good compilers on many platforms
- allows C-like data structures and mixed language modules
- provides structure that begins to be object-based
- allows long variable names (up to 32 characters)
- provides backward compatibility during the development process

We began working on EnergyPlus by modularizing (restructuring) code from the heat balance engine in IBLAST, a research version of BLAST with integrated loads and HVAC calculation [TAY 90, 91]. Normally such restructuring would result in major rewrites involving a long development period, and very extensive testing to ensure the new code performs as intended. However, because the EnergyPlus team selected Fortran 90 (and Fortran 77 is a subset of Fortran 90), development is proceeding through a process which we call Evolutionary Reengineering (ER). This process incrementally moves the program from old unstructured legacy code to new modular code by incorporating new code with old. The existing code still works with user input data, and is extended to generate parameters needed by the new code modules. In this way the new modules can be verified without having to completely replace the entire functional capability of the old program with new code before it can be tested. As the process proceeds, the parameters supplied by old routines are replaced by new routines and data structures. This makes the transition evolutionary and permits a smooth transition with a greater capability for verification testing.

**ENERGYPLUS STRUCTURE**

In two recent workshops on next generation energy tools sponsored by DOE and DOD [CRA 97] there was strong consensus that a more flexible and robust tool with additional capabilities was needed. Recurrent themes for simulation needs throughout the workshops were design, environment, economics, and occupant comfort and safety. Designers need tools that provide answers to very specific questions during design. They want tools that provide the highest level of simulation accuracy and detail reasonably possible but that don't get in the user's way. One of the highest priorities was an integrated (simultaneous) simulation for accurate temperature and comfort prediction.

In response to these findings, we decided that integrated simulation should be the underlying concept for EnergyPlus—loads calculated (by a heat balance engine) at a user-specified time step (15-minute default) are passed to the building systems simulation module at the same time step. The building systems simulation module, with a variable time step (down to seconds), calculates heating and cooling system and plant and electrical system response. Feedback from the building systems simulation module on loads not met is reflected in the next time step of the load calculations in adjusted space temperatures if necessary.

By using an integrated solution technique in EnergyPlus, the most serious deficiency of the BLAST and DOE–2 sequential simulations can be solved—inaccurate space temperature predication due to no feedback from the HVAC module to the loads calculations. Accurate prediction of space temperatures is crucial to energy efficient system engineering—system size, plant size, occupant comfort and occupant health are dependent on space temperatures.

Integrated simulation also allows users to evaluate a number of processes that neither BLAST nor DOE–2 can simulate well. Some of the more important include:

- Realistic system controls
- Moisture adsorption and desorption in building elements
- Radiant heating and cooling systems
- Interzone air flow

Figure 1 shows the overall program structure. EnergyPlus has three basic components—a simulation manager, a heat balance simulation module, and a building systems simulation module. The simulation manager controls the entire simulation process. The heat balance calculations are based on IBLAST—a research version of BLAST with integrated HVAC systems and building loads simulation.

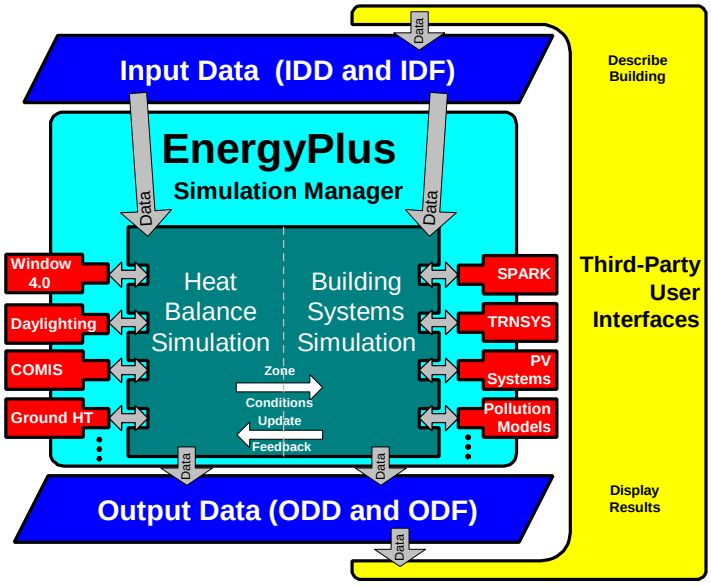


**Figure 1 Overall EnergyPlus Structure**

A new building systems simulation manager handles communication between the heat balance engine and various HVAC modules and loops, such as coils, boilers, chillers, pumps, fans, and other equipment/components. (In the first release, the building systems simulation manager only has HVAC systems and equipment / components. Future releases of EnergyPlus will include electrical systems simulation.). The building systems simulation manager also controls inter-action and data exchange between EnergyPlus and SPARK [BUH 93] and HVACSIM+ [MET 95] simulations. Gone are the hardwired "template" systems (VAV, Constant Volume Reheat, etc.) of DOE–2 and BLAST—they are replaced by user-configured heating and cooling equipment components formerly within the template. This gives users much more flexibility in matching their simulation to the actual system configurations. The building systems simulation module also manages data communication between the HVAC modules, input data, and output data structures.

A comparison of major features and capabilities of EnergyPlus, BLAST, IBLAST, and DOE–2 are shown in Tables 1, 2, and 3. Table 1 shows general features, Table 2 shows load calculation features, and Table 3 shows HVAC features.

**Table 1 Comparison of General Features and Capabilities**

| General Feature | DOE-2 | BLAST | IBLAST | EnergyPlus |
|---|---|---|---|---|
| **Integrated, Simultaneous Solution**<br>• Integrated loads/systems/plant<br>• Iterative solution<br>• Tight coupling | No | No | **Yes** | **Yes** |
| **Multiple Time Step Approach**<br>• User-defined time step for interaction between zones and environment (15-minute default)<br>• Variable time-step for interactions between zone air mass and HVAC system (≥ 1 minute) | No | No | **Yes** | **Yes** |
| **Input Functions**<br>• Users can modify code without recompiling | **Yes** | No | No | **Yes** |
| **New Reporting Mechanism**<br>• User-definable reports | No | No | No | **Yes** |

**Table 2 Comparison of Loads Features and Capabilities**

| Loads Feature | DOE-2 | BLAST | IBLAST | EnergyPlus |
|---|---|---|---|---|
| **Heat Balance Calculation**<br>• Simultaneous calculation of radiation and convection processes each time step | No | **Yes** | **Yes** | **Yes** |
| **Interior Surface Convection** | | | | |
| • Dependent on temperature and air flow | No | **Yes** | **Yes** | **Yes** |
| • Internal thermal mass | **Yes** | **Yes** | **Yes** | **Yes** |
| **Moisture Absorption/Desorption**<br>• Combined heat and mass transfer in building envelopes | No | No | **Yes** | **Yes** |
| **Thermal Comfort**<br>• Human comfort model based on activity, inside drybulb, humidity, and radiation | No | **Yes** | **Yes** | **Yes** |
| **Anisotropic Sky Model**<br>• Sky radiance depends on sun position for better calculation of diffuse solar on tilted surfaces | **Yes** | No | No | **Yes** |
| **Advanced Fenestration Calculations** | | | | |
| • Controllable window blinds | **Yes** | No | No | **Yes** |
| • Layer-by-layer glazing input | **Yes** | **Yes** | **Yes** | **Yes** |
| • Electrochromic glazing | **Yes** | **No** | **No** | **Yes** |
| **WINDOW 4 Library**<br>• More than 200 window types—conventional, reflective, low-E, gas-fill, electrochromic<br>• User defined using WINDOW 4 | **Yes** | **Yes** | **Yes** | **Yes** |
| **Daylighting Illumination and Controls**<br>• Interior illuminance from windows and skylights<br>• Stepped, dimming, on/off luminaire controls<br>• Glare simulation and control<br>• Effects of dimming on heating and cooling | **Yes** | No | No | **Yes** |

**Table 3 Comparison of HVAC Features and Capabilities**

| HVAC Systems and Equipment Feature | DOE-2 | BLAST | IBLAST | EnergyPlus |
|---|---|---|---|---|
| **Fluid Loops**<br>• Connect primary equipment and coils<br>• Hot water loops, chilled water and condenser loops, refrigerant loops | **Yes** | No | No | **Yes** |
| **Air Loops**<br>• Connect fans, coils, mixing boxes, zones | No | No | No | **Yes** |
| **User-configurable HVAC systems** | No | No | No | **Yes** |
| **Hardwired Template HVAC systems** | **Yes** | **Yes** | **Yes** | No |
| **High-Temperature Radiant Heating**<br>• Gas/electric heaters, wall radiators | No | **Yes** | No | **Yes** |
| **Low-Temperature Radiant Heating/Cooling**<br>• Heated floor/ceiling<br>• Cooled ceiling | No | No | **Yes** | **Yes** |
| **Atmospheric Pollution Calculation**<br>• $CO_2$, $SO_x$, $NO_x$, CO, particulate matter and hydrocarbon production<br>• On-site and at power plant<br>• Calculate reductions in greenhouse gases | **Yes** | **Yes** | No | **Yes** |
| **SPARK Connection** | No | No | No | **Yes** |
| **TRNSYS Connection** | No | No | No | **Yes** |

**Simulation Management**

At the outermost program level, the Simulation Manager (shown schematically in Figure 2) controls the interactions between all simulation loops from a sub-hour level up through the user selected time step and simulation period—whether day, month, season, year or several years. Actions of individual simulation modules are directed by the simulation manager, instructing simulation modules to take actions such as initialize, simulate, record keep, or report.

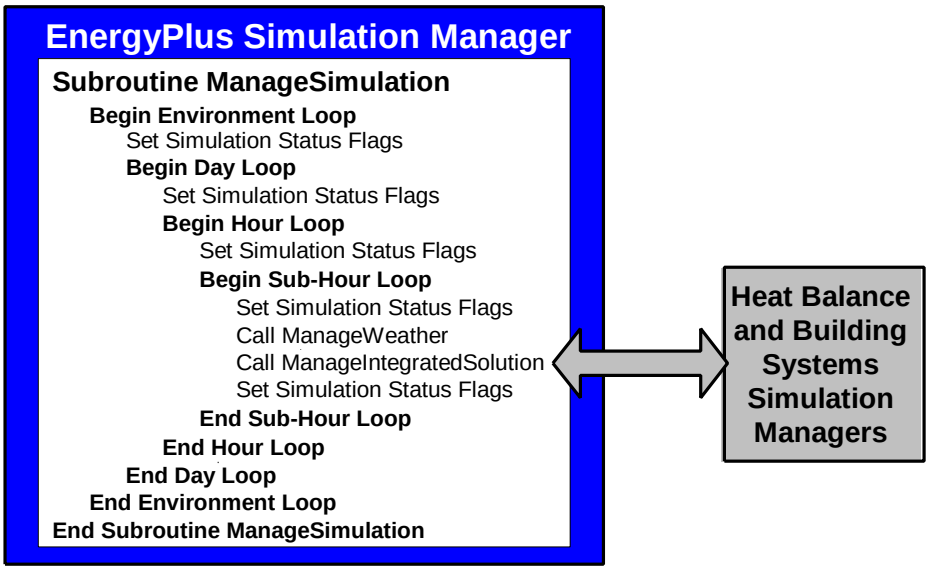


**Figure 2 EnergyPlus Simulation Manager**

Figure 3 shows the structure of the EnergyPlus integrated solution manager that manages the surface and air heat balance modules and acts as an interface between the heat balance and the building systems simulation manager. The surface heat balance module simulates inside and outside surface heat balance, interconnections between heat balances and boundary conditions, conduction, convection, radiation, and mass transfer (water vapor) effects. The air mass balance module deals with various mass streams such as ventilation air, exhaust air, and infiltration. It accounts for thermal mass of zone air and evaluates direct convective heat gains. Through this module that we are connecting to COMIS [FEU 90] for improved multi-zone airflow, infiltration, indoor contaminant, and ventilation calculations.

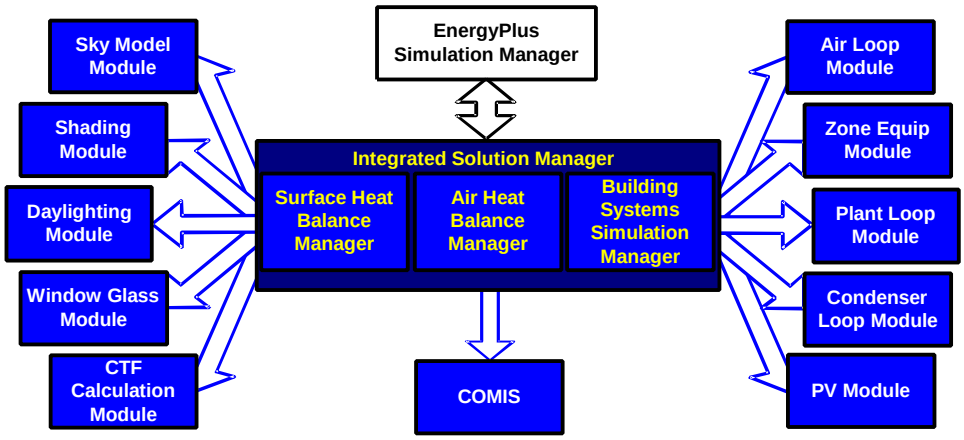


**Figure 3 Integrated Simulation Manager**

We created the simulation manager to specifically address the legacy issues of spaghetti code and lack of structure in DOE–2 and BLAST. The simulation manager provides several critical benefits:

- major simulation loops are contained in a single module
- modules are self-contained and more object-based
- data access is controlled
- new modules are easily added

**Heat and Mass Balance**

As noted earlier, the underlying building thermal zone calculation method in EnergyPlus is a heat balance model. The fundamental assumption of heat balance models is that air in each thermal zone can be modeled as well stirred with uniform temperature throughout. Although this does not reflect physical reality well, the only current alternative is Computational Fluid Dynamics (CFD)—a complex and computationally intensive simulation of fluid (in this case, air) movement. Currently, CFD is most useful in research applications. Several groups are developing models somewhere between the well-stirred model and a full CFD calculation. The modular structure of EnergyPlus allows these new models to be included in future releases once they are available. The other major assumption in heat balance models is that room surfaces (walls, windows, ceilings, and floors) have:

- uniform surface temperatures,
- uniform long and short wave irradiation,
- diffuse radiating surfaces, and
- internal heat conduction.

In addition to the basic heat balance engine from IBLAST, we are creating three new modules based on capabilities within DOE–2: daylighting illumination [WIN 85], WINDOW 4-based fenestration [ARA 94], and anisotropic sky. The daylighting module calculates hourly interior daylight illuminance, glare from windows, glare control, electric lighting controls (on/off, stepped and continuous dimming), and electric lighting reduction for the heat balance module. In the future, the daylighting module will include an improved interior inter-reflection calculation, light shelves, roof monitors, and reflection from neighboring buildings. The fenestration module includes capabilities from WINDOW 4—accurate angular dependence of transmission and absorption for both solar and visible radiation, and temperature-dependent U-value. Users can enter a layer-by-layer window description or choose windows from the library (conventional, reflective, low-e, gas fill electrochromic). Also simulated are movable window shades for sun and/or glare control. In the near future, the algorithms will be upgraded to the WINDOW 5 algorithms for coatings and framing elements. The sky model includes non-isotropic radiance and luminance distribution throughout the sky based on the empirical model by Perez as a function of sun position and cloud cover. This non-uniform radiance distribution improves calculation of diffuse solar on tilted surfaces (walls and sloped roofs).

Several other modules have been re-engineered for inclusion in EnergyPlus: solar shading from BLAST and conduction transfer function calculations from IBLAST. The major enhancements of the IBLAST (and EnergyPlus) heat balance engine over BLAST include mass transfer and radiant heating and cooling. The mass transfer capability within EnergyPlus allows fundamental, layer-by-layer solution for mass transfer through surfaces and a mass balance on zone air similar to the air heat balance. The radiant heating and cooling models are an expansion of the conduction transfer function and incorporate thermal comfort calculations. This provides a means for improved modeling and control capabilities for the new building systems simulation manager.

One last important feature of the EnergyPlus heat balance engine is that it is essentially identical in functionality to the Loads Toolkit being developed by UI under ASHRAE RP-987. UI is developing both the Loads Toolkit and the EnergyPlus heat and mass balance engine and is using the programming standard developed in the EnergyPlus project to produce the Loads Toolkit. Both projects benefit—modularization efforts started by EnergyPlus will be useful in the Loads Toolkit and new component models developed for the Loads Toolkit will enhance EnergyPlus.

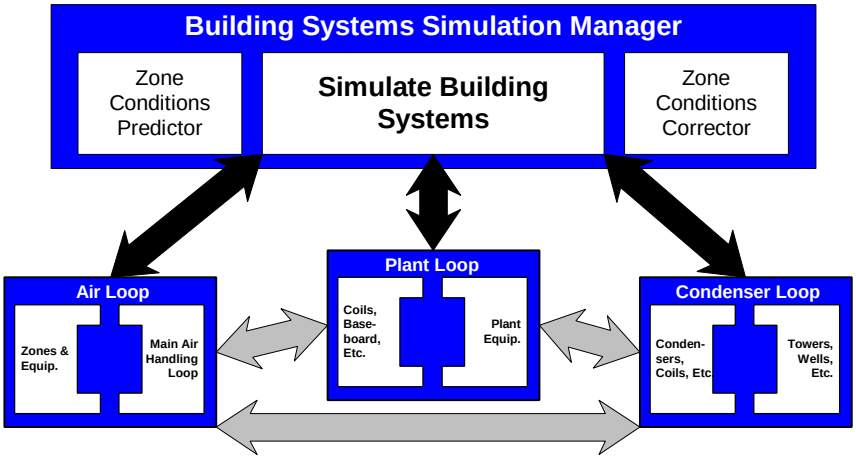


**Figure 4 Building Systems Simulation Manager**

**Building Systems Simulation Manager**

After the heat balance manager completes simulation for a time step, it calls the Building Systems Simulation Manager (see Figure 4) which controls the simulation of HVAC and electrical systems, equipment and components and updates the zone-air conditions. EnergyPlus does not use a sequential simulation method (first building loads, then air distribution system, and then central plant) as found in DOE–2 and BLAST since this imposes rigid boundaries on program structures and limits input flexibility. Instead, we designed the building systems simulation manager with several objectives in mind:

- fully integrated simulation of loads, systems, and plant
- modular
- extensible

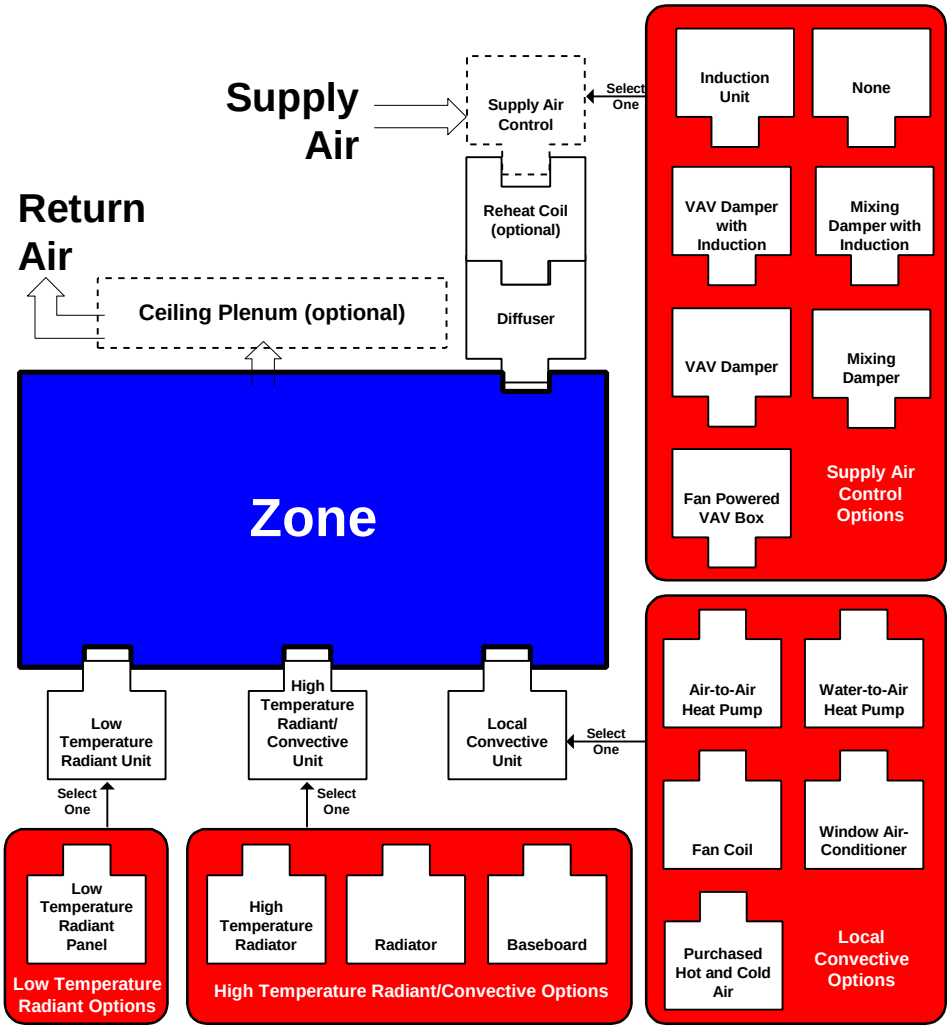


**Figure 5 Zone Equipment Module**

Integrated simulation models capacity limits more realistically and tightly couples the air and water side of the system and plant. Modularity is maintained at both the component and system level. This eases adding new components and flexibly modeling system configurations and, at the system level, equipment and systems are clearly connected to zone models in the heat balance manager. To implement these concepts, we use loops throughout the building systems simulation manager—primarily HVAC air and water loops. Loops mimic the network of pipes and ducts found in real buildings and eventually will simulate head and thermal losses that occur as fluid moves in each loop. As mentioned earlier, EnergyPlus has no hardwired "template" systems. Instead, we developed input file templates for the each of the major system types in BLAST and DOE–2. These templates provide an easy starting point for users with system configurations that differ from "default" configurations. The air loop simulates air transport, conditioning, and mixing and includes supply and return fans, central heating and cooling coils, heat recovery, and controls for supply air temperature and outside air economizer. The air loop connects to the zone through the zone equipment. Zone equipment includes diffusers, reheat/recool coils, supply air control (mixing dampers, fan-powered VAV box, induction unit, VAV dampers), local convection units (window air-conditioning, fan coil, water-to-air heat pump, air-to-air heat pump), high temperature radiant/convective units (baseboard, radiators) and low temperature radiant panels. Figure 5 shows equipment connections to zones—note that more than one equipment type

can be specified for a zone. However, users must specify equipment in the order it will be used to meet zone heating and cooling demand.

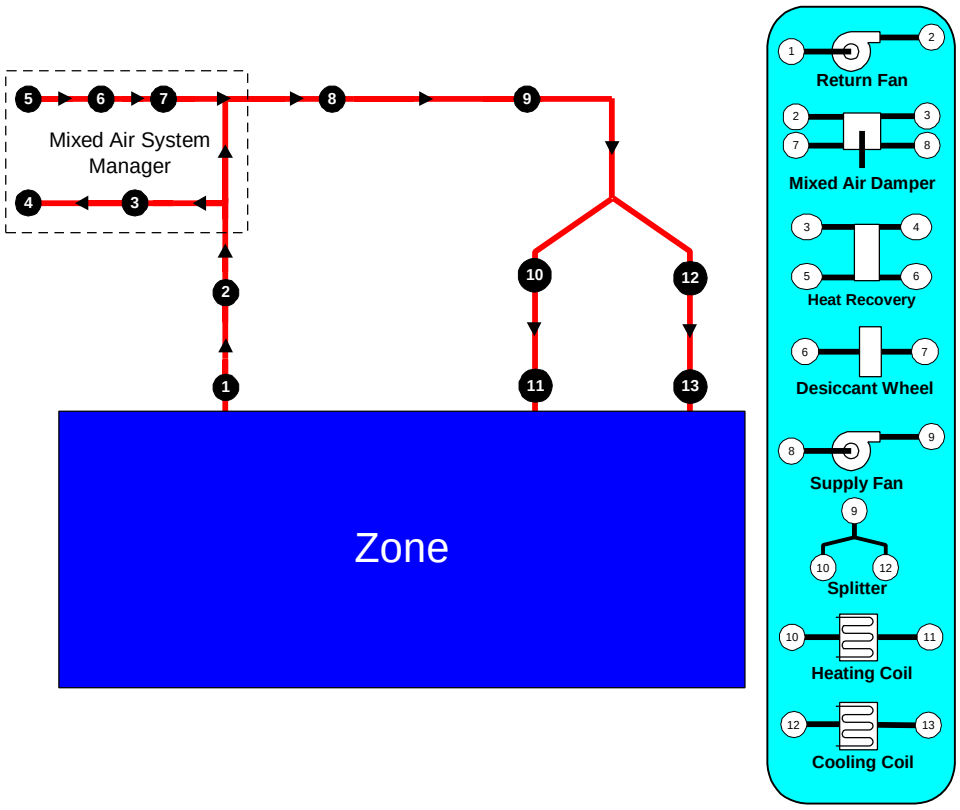


**Figure 6 Simple Air Loop Node Diagram**

For the air loop, the solution method is iterative, not single-pass as in DOE–2 and BLAST. In order to specify equipment connections to a loop, nodes are defined at key locations around the loop with each node assigned a unique numeric identifier as shown in Figure 6. Node identifiers store loop state variables and set-point information for that location in the loop. We use an iterative solution technique to solve for unknown state variables along with control equation representations. These representations connect the set points at one node with the control function of a component, such as fan damper position and cooling coil water flow rate. In this schema, all the loop components are simulated first, then the control equations are updated using explicit finite difference. This procedure continues until the simulation converges. Typical control schemes are included in the input file templates described earlier.

There are two loops for HVAC plant equipment—a primary loop (for supply equipment such as boilers, chillers, thermal storage, and heat pumps) and a secondary loop (for heat rejection equipment such as cooling towers and condensers). Figure 7 presents a schematic view of equipment connections on the primary plant loop. Equipment is specified by type (gas-fired boiler, open drive centrifugal chiller) and its operating characteristics. In the first release of EnergyPlus, we are supporting performance-based equipment models (such as in BLAST and DOE–2). But because of the modular code, it will be easy for developers to add other types of models. As in the air loop, the primary and secondary plant loops use explicit nodes to connect equipment to each loop. Connections between the air loop and zone equipment and the primary and secondary loops are made through the node data structure and must be explicitly defined in the input file.

A similar loop approach is proposed for a new electrical loop for simulating electrical systems—supply (utility, photovoltaic modules, and fuel cells), demand (plug loads, lighting, and other electrical loads), and measurement (meters).

In the longer term, EnergyPlus users will have more systems and equipment options through a link to SPARK [BUH 93], a new equation-based simulation tool. SPARK is a better solver for complex iterative problems and is currently in beta testing. SPARK already has a library of HVAC components based on the ASHRAE primary and secondary toolkits. EnergyPlus will continue to have system types (in input file templates) but developers and advanced users will be able to easily build complex new HVAC models with SPARK.

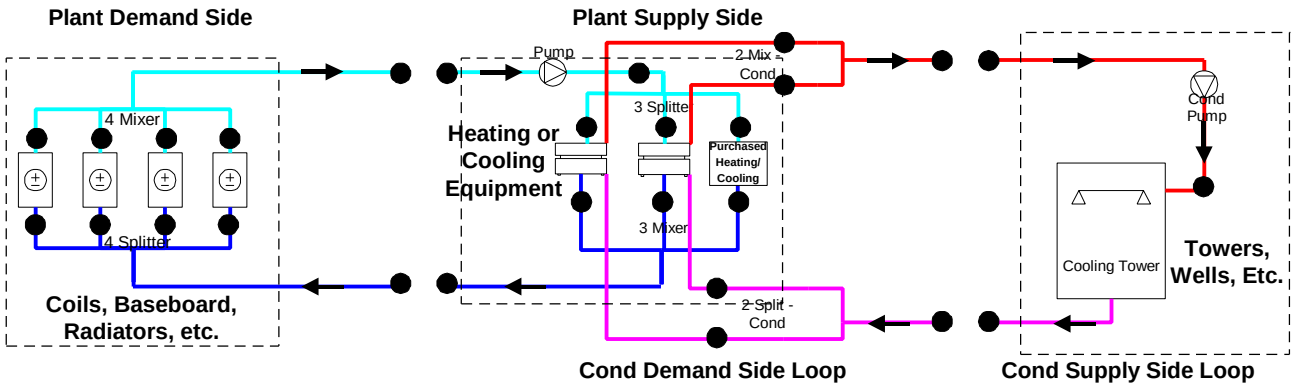


**Figure 7 Example Plant Loop**

**INPUT, OUTPUT, AND WEATHER DATA**

Both DOE–2 and BLAST have highly-structured but user readable input file definitions that have evolved over many years. Instead of user readability, we designed the EnergyPlus input data files for easy maintenance and expansion. We chose to keep the input file simple in order to accept simulation input data from other sources such as CADD systems, programs that also do other functions, and pre-processors similar to those written for BLAST and DOE–2. An EnergyPlus input file, while readable, is cryptic and definitely not user-friendly—it is not intended to be the main interface for typical end-users. We expect most users will use EnergyPlus through an interface from a third-party developer. To make it easy for current DOE–2 and BLAST users to move to EnergyPlus, the team has written utilities that convert BLAST and DOE–2 input to the new EnergyPlus input structure.

Depending on how quickly the International Alliance for Interoperability (IAI) progresses in defining a de facto standard for building information exchange, a common object-oriented data store such as the IAI's proposed Industry Foundation Classes [BAZ 97] may eventually become the main interface to the program.

EnergyPlus uses a free format input file that contains a complete object-based description of the building and its systems. The basic syntax is:

```
object, name, value, value, . . ., value;
```

"Object" is a pre-defined word denoting a building component, such as WALL, MATERIAL, LIGHTING, SYSTEM, HEATING COIL, and BOILER. This word is followed by a list of data values and terminates with a semicolon. These data describe performance characteristics and intended use for that object in the simulation. Unlike BLAST and DOE–2, the input file must explicitly provide all information—there are no default assumptions. Users may include comments throughout their input data file. A comparison of input file syntax for BLAST, DOE–2, and EnergyPlus is shown in Table 4.

During a simulation, EnergyPlus saves results for each time step in an output data structure. HVAC results are aggregated and reported at the time step. This structure uses a similar philosophy to the input—simple text files with a syntax of object, time stamp, data, data, data, . . ., data; . The output data is simple yet contains all the simulation results so that users and interface developers cam easily access specific results without modifying the calculation engine. Four types of reports are planned—standard output (aggregate hourly time step), one time output (such as input echo), detailed output (user-defined time step), and standard reports such as those in BLAST and DOE–2. Because the data structure is simple and comma-separated, output post-processors can easily read the data and create more elaborate reports. One drawback of our simple file format is that the output files can become very large.

The other major data input is weather. Rather than a binary file created by a separate weather processor, again we use a simple text-based format, similar to the input data and output data files. The weather data format includes basic location information in the first eight lines: location (name, state/province/region, country), data source, latitude, longitude, time zone, elevation, peak heating and cooling design conditions, holidays, daylight savings period, typical and extreme periods, two lines for comments, and period covered by the data. The data are also comma-separated and contain much of the same data in the TMY2 weather data set [NRE 95]. EnergyPlus does not require a full year or 8760 (or 8784) hours in its weather files. In fact, EnergyPlus allows and reads subsets of years and even sub-hourly (5 minute, 15 minute) data—the weather format includes a "minutes" field. EnergyPlus comes with a utility that reads standard weather service file types such as TD1440 and DATSAV2 and newer "typical year" weather files such as TMY2 and WYEC2.

In summary, all the data files associated with EnergyPlus—input, output, and weather—have simple self-contained formats but they can become quite large. The data files can be easily read and interpreted by other programs—spreadsheets, databases, or custom programs. By working with third party interface developers early, we will keep these files simple and easy to use by other programs that building designers use.

**Table 4 Comparison of BLAST, DOE-2 (BDL) and EnergyPlus Input**

| | | BLAST | BDL (DOE-2) | EnergyPlus |
|---|---|---|---|---|
| **Location (Simple Input)** | Description | Location defined in library. Library includes name, latitude, longitude, elevation, and time zone. | Location information defined by input, defaults to information on weather file | Location information defined by input. |
| | Input Syntax | LOCATION = Name; | BUILDING-LOCATION<br>Latitude = W,<br>Longitude = X,<br>Altitude = Y,<br>Time-Zone = Z .. | LOCATION, Name, Latitude, Longitude, Elevation, TimeZone; |
| | Example Input | **LOCATION = CHICAGO;** | **BUILDING-LOCATION<br>LATITUDE = 41.98<br>LONGITUDE = 87.90<br>ALTITUDE = 673<br>TIME-ZONE = 6 ..** | **LOCATION,<br>Chicago Illinois USA,<br>41.98, 87.90, 205, -6;** |
| **Material (More Complex)** | Description | Material defined in library. Library includes material name, conductivity, density, specific heat, resistance, roughness, and moisture properties. | Material from library or defined in input, includes thickness, conductivity, density, specific heat, or resistance. Thickness restated during Layer input (optional). | All material information defined by input. |
| | Input Syntax | TEMPORARY MATERIAL: Usname = (L=usn1, K=usn2, CP=usn3, D=usn4, ABS=usn5, TABS=usn6, R=usn7, TRANS=usn8, IR=usn9, FILMTRANS=usn10, REF=usn11, SC=usn12, roughness,asg); END; | A = Material,<br>Thickness = W,<br>Conductivity = X, Density = Y,<br>Specific Heat = Z .. | MATERIAL,<br>Name,<br>Thickness, Conductivity, Density,<br>Specific Heat, Roughness, Moisture Permeance, Moisture Resistance; |
| | Example Input | **Brick = (L=0.3333, K=5.6, CP=0.19, D=120, ROUGH);** | **BRICK = MATERIAL<br>THICKNESS = 0.3333<br>CONDUCTIVITY = 5.6<br>DENSITY = 120<br>SPECIFIC-HEAT = 0.19 ..** | **MATERIAL,<br>Brick, 0.1016, 0.721, 1922, 837, 46, 0.022;** |

**ADDING A NEW MODULE**

One of the main goals for EnergyPlus is to make it easy for developers to add new features and modules. The process is relatively simple. First, a developer defines a new module with model parameters and equations, specialized coefficients, and data needed. A developer then finds the "plug-in" point—where the module would be called within EnergyPlus. Next the developer writes the module (using the EnergyPlus programming standard), breaking the simulation tasks into modules. Finally, the developer writes new input file syntax based on the input needed for the module and uses EnergyPlus "get" routines to read the needed input data into the new simulation module. The input file syntax is not hardwired within EnergyPlus; instead EnergyPlus reads an input data dictionary at runtime to determine the syntax of the input data file. The general syntax is:

```
Object, A1 [what this is], N1 [a number],...;
```

For example, for the EnergyPlus Location command, the data dictionary line is:

```
Location, A1 [Location Name], N1 [Latitude], N2 [Longitude], N3 [Elevation], N4
[Time Zone];
```

This tells the input processor that, for the Location command, to expect one text field (A1) with the location name, and four numeric inputs (N1, N2, N3, and N4)–latitude, longitude, elevation, and time zone respectively. Words in brackets [ ] describe the variable and its units (meters, liters/second, etc.).

**RELEASE 1.0 AND BEYOND**

*"More people have ascended bodily into heaven than have shipped great software on time." [McC 95]*

The first working version of EnergyPlus, or alpha version, was completed in December 1998 for internal testing by the team. The alpha version did not contain all the modules intended for the first release of EnergyPlus—those will be included in the first beta version, an internal version for testing that will be completed in Spring 1999. By Summer 1999, a beta version will be available to outside developers for testing. Shortly thereafter, a beta test version will be available for general testing. We plan to release version 1.0 of EnergyPlus in early 2000.

In late 1999 we will begin planning for the second release of EnergyPlus based on new features suggested by users, developers, and the team. Working with a coordinating group of users and developers, we will select the features and capabilities for that release. We plan to release updates to EnergyPlus on an 18-month release cycle. Some new features already under development are a connection to the COMIS airflow program, improved ground heat transfer, electrical system simulation, solar thermal and photovoltaic modules, and link to SPARK. The link to COMIS will allow better calculation of infiltration, natural ventilation, multi-zone airflow, and air pollutant transport. The ground heat transfer model will either be a 2-dimensional or 3-dimensional heat transfer calculation for various foundation calculations.

**SUMMARY**

EnergyPlus is a new building energy simulation program that builds on the strengths of BLAST and DOE–2. It is being written in Fortran 90 with structured, modular code that is easy to maintain, update, and extend. Benefits of EnergyPlus include:

For simulation program users:

- limits built into BLAST and DOE–2 (such as number of zones, schedules, or systems) are eliminated by the new structures in EnergyPlus—now limited only by a user's computer resources rather than hardwired in code
- EnergyPlus source code is open for inspection—and understandable
- developers around the world will be able to develop new modules—algorithmic or interfaces
- new module development can keep pace with new building technologies, maximizing public impact of latest buildings research

For simulation developers:

- standardized structure significantly decreases the learning curve for developers
- new, structured, modular code is easier to understand and work with
- modular structure allows developers to work in parallel on new modules

General benefits include:

- simulation capabilities include integrated simulation, combined heat and mass transfer balance, multi-zone airflow, HVAC loops (flexible system and plant simulation), links to SPARK system/plant simulation, and algorithms from the new ASHRAE Loads Toolkit
- input, output, and simulation capabilities are much more flexible
- EnergyPlus will be released quicker than a next-generation program, but offer similar benefits

Although the two workshops sponsored by DOE and DOD [CRA 97] pointed up the critical need for good user interfaces in the success of any simulation tool, the EnergyPlus team is focusing first on developing the heart of a new simulation tool—the calculation engine. We consciously incorporated the priorities of the workshop participants in our development effort (many can be seen in Figure 1). The EnergyPlus team has begun working with third party interface developers to ensure user-friendly interfaces and new modules are ready when the program is released.

EnergyPlus not only combines the best features of the BLAST and DOE–2 programs, but also represents a significant step towards next-generation building simulation programs both in terms of computational techniques and program structures. Connectivity and extensibility are overriding objectives in the design and development process. This will ensure broad participation in program enhancement and facilitate third party interface and module development. EnergyPlus beta testing begins in early 1999. Up to date information on EnergyPlus is provided on the EnergyPlus web site.

**WEB RESOURCES**

1. Information on EnergyPlus including schedule, documentation, programming standards, and availability of beta releases: **www.eren.doe.gov/buildings/energy_tools/energyplus.htm**
2. Workshops on Next Generation Energy Simulation Tools: **www.eren.doe.gov/buildings/energy_tools/workshops.htm**
3. Web-based directory of more than 130 building-related software tools from around the world: **www.eren.doe.gov/buildings/tools_directory/**

**REFERENCES**


ARA 94 Arasteh, D. K., E. U. Finlayson, and C. Huizenga. 1994. *Window 4.1: Program Description*, Lawrence Berkeley National Laboratory, report no LBL-35298. Berkeley, California: Lawrence Berkeley Laboratory.

BAZ 97 Bazjanac, Vladimir, and Drury B. Crawley. 1997. "International Alliance for Interoperability: The Implementation of Industry Foundation Classes in Simulation Tools for the Building Industry," in *Proceedings of Building Simulation '97*, Volume I, pp.203-210, September 1997, Prague, Czech Republic, IBPSA.

BLA 92 BLAST Support Office. 1992. *BLAST 3.0 Users Manual*. Urbana-Champaign, Illinois: BLAST Support Office, Department of Mechanical and Industrial Engineering, University of Illinois.

BUH 93 Buhl, W.F., A.E. Erdem, F. C. Winkelmann and E. F. Sowell. 1993. "Recent Improvements in SPARK: Strong-Component Decomposition, Multivalued Objects and Graphical Editors," in *Proceedings of Building Simulation '93*, pp. 283-289, August 1993, Adelaide, South Australia, Australia, IBPSA.

CRA 97 Crawley, D. B., L. K. Lawrie, F. C. Winkelmann, W. F. Buhl, A. E. Erdem, C. O. Pedersen, R. J. Liesen, and D. E. Fisher. 1997. "The Next-Generation in Building Energy Simulation—A Glimpse of the Future," in *Proceedings of Building Simulation '97*, Volume II, pp. 395-402, September 1997, Prague, Czech Republic, IBPSA.

FEU 90 Feustel, H. E. 1990. "The COMIS Air-Flow Model – A Tool for Multi-zone Applications," in *Proceedings of the 5th International Conference on Indoor Air Quality and Climate*, Vol. 4, pp. 121-126.

McC 95 McCarthy, Jim. 1995. *Dynamics of Software Development*, pg. 2. Redmond, Washington: Microsoft Press.

MET 95 Metcalf, R. R., R. D. Taylor, C. E. Pedersen, R. J. Liesen, and D. E. Fisher. 1995. "Incorporating a Modular System Simulation Program into a Large Energy Analysis Program: the Linking of IBLAST and HVACSIM+, " in *Proceedings of Building Simulation '95*, pp. 415-422, August 1995, Madison, WI, IBPSA.

NRE 95 National Renewable Energy Laboratory (NREL). 1995. *User's Manual for TMY2s (Typical Meteorological Years)*, NREL/SP-463-7668, and TMY2s, Typical Meteorological Years Derived from the 1961-1990 National Solar Radiation Data Base, June 1995, CD-ROM. Golden, Colorado: NREL.

TAY 90 Taylor, R. D, C. E. Pedersen, and L. K. Lawrie. 1990. "Simultaneous Simulation of Buildings and Mechanical Systems in Heat Balance Based Energy Analysis Programs," in *Proceedings of the 3rd International Conference on System Simulation in Buildings*, Liege, Belgium, December 3-5, 1990.

TAY 91 Taylor R. D., C. E. Pedersen, D. E. Fisher, R. J. Liesen, and L. K. Lawrie. 1991. "Impact of Simultaneous Simulation of Building and Mechanical Systems in Heat Balance Based Energy Analysis Programs on System Response and Control," in *Proceedings of Building Simulation '91*, August 1991, Nice, France.

WIN 85 Winkelmann, F. C. and S. E. Selkowitz. 1985. "Daylighting Simulation in the DOE–2 Building Energy Analysis Program," in *Energy and Buildings*, 8, pp. 271-286.

WIN 93 Winkelmann, F. C., B. E. Birdsall, W. F. Buhl, K. L. Ellington, A. E. Erdem, J. J. Hirsch, and S. Gates. 1993. *DOE–2 Supplement, Version 2.1E*, LBL-34947, November 1993, Lawrence Berkeley National Laboratory. Springfield, Virginia: National Technical Information Service.

# "BLDG SIM" Mailing List

BLDG-SIM is a new mailing list for users of building energy simulation programs. These programs allow users to estimate the energy use and operating cost of residential, commercial, and other types of buildings. Design professional can then compare alternative designs and select the one that is cost justified. Building energy simulation programs are frequently used during the design process when choosing among alternatives in the components that make up a building, including insulation level, heating and cooling distribution systems, furnaces, boilers and air conditioning equipment. The web page for the "BLDG SIM" mailing list is located at:

**www.gard.com/ml/bldg-sim.htm**

Since the users of building energy simulation programs are spread across the world, this mailing list is an attempt to foster the development of a community of those users. All levels of building simulation program users are welcome and are encouraged to share their questions and insights. Examples of building simulation programs include DOE-2, BLAST, TRACE-600, ESP, SERI-RES, TASE, TRNSYS, Energy-10 and others. The DOE Building Energy Tools Directory provides a more complete list:

**www.eren.doe.gov/buildings/tools_directory**

Questions should be directed to Jason Glazer, who manages the list: jglazer@gard.com or (847) 698-5686.

Here is an example of the first message we received after subscribing to the list:

> "Here is a tip when using DOE-2 macro language and the ##elseif command. Some versions of DOE-2 will include more than one elseif block of code in an if-elseif-elseif-else- endif structure if the conditions on each elseif are true. This is different than most programming languages that will only include the block of code in the first elseif that is true. This is a small tip but it would have saved me a few hours of effort a year ago.
>
> Does anyone have any other undocumented tips for building simulation programs?
>
> Jason"

## *User News* Deadlines for 1999-2000

**Shaded days on the calendar indicate deadline dates for either submission of articles or changes to vendor information. We always welcome articles about innovative uses for DOE-2, BLAST and their derivatives.**

**1999**

| Apr | | | | | May | | | | | Jun | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | Tu | W | Th | F | M | Tu | W | Th | F | M | Tu | W | Th | F |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 14 | 15 | 16 | 17 | 18 |
| 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 21 | 22 | 23 | 24 | 25 |
| 26 | 27 | 28 | 29 | 30 | 31 | | | | | 28 | 29 | 30 | | |

| Jul | | | | | Aug | | | | | Sep | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | Tu | W | Th | F | M | Tu | W | Th | F | M | Tu | W | Th | F |
| | | | 1 | 2 | 2 | 3 | 4 | 5 | 6 | | | 1 | 2 | 3 |
| 5 | 6 | 7 | 8 | 9 | 9 | 10 | 11 | 12 | 13 | 6 | 7 | 8 | 9 | 10 |
| 12 | 13 | 14 | 15 | 16 | 16 | 17 | 18 | 19 | 20 | 13 | 14 | 15 | 16 | 17 |
| 19 | 20 | 21 | 22 | 23 | 23 | 24 | 25 | 26 | 27 | 20 | 21 | 22 | 23 | 24 |
| 26 | 27 | 28 | 29 | 30 | 30 | 31 | | | | 27 | 28 | 29 | 30 | |

| Oct | | | | | Nov | | | | | Dec | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | Tu | W | Th | F | M | Tu | W | Th | F | M | Tu | W | Th | F |
| | | | | 1 | 1 | 2 | 3 | 4 | 5 | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 12 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 15 | 16 | 17 | 18 | 19 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 26 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 29 | 30 | | | | 27 | 28 | 29 | 30 | 31 |

**2000**

| Jan | | | | | Feb | | | | | Mar | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | Tu | W | Th | F | M | Tu | W | Th | F | M | Tu | W | Th | F |
| 3 | 4 | 5 | 6 | 7 | | 1 | 2 | 3 | 4 | | | 1 | 2 | 3 |
| 10 | 11 | 12 | 13 | 14 | 7 | 8 | 9 | 10 | 11 | 6 | 7 | 8 | 9 | 10 |
| 17 | 18 | 19 | 20 | 21 | 14 | 15 | 16 | 17 | 18 | 13 | 14 | 15 | 16 | 17 |
| 24 | 25 | 26 | 27 | 28 | 21 | 22 | 23 | 24 | 25 | 20 | 21 | 22 | 23 | 24 |
| 31 | | | | | 28 | 29 | | | | 27 | 28 | 29 | 30 | 31 |

| Apr | | | | | May | | | | | Jun | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | Tu | W | Th | F | M | Tu | W | Th | F | M | Tu | W | Th | F |
| 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | | | | 1 | 2 |
| 10 | 11 | 12 | 13 | 14 | 8 | 9 | 10 | 11 | 12 | 5 | 6 | 7 | 8 | 9 |
| 17 | 18 | 19 | 20 | 21 | 15 | 16 | 17 | 18 | 19 | 12 | 13 | 14 | 15 | 16 |
| 24 | 25 | 26 | 27 | 28 | 22 | 23 | 24 | 25 | 26 | 19 | 20 | 21 | 22 | 23 |
| | | | | | 29 | 30 | 31 | | | 26 | 27 | 28 | 29 | 30 |

| Jul | | | | | August | | | | | Sept | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | Tu | W | Th | F | M | Tu | W | Th | F | M | Tu | W | Th | F |
| 3 | 4 | 5 | 6 | 7 | | 1 | 2 | 3 | 4 | | | | | 1 |
| 10 | 11 | 12 | 13 | 14 | 7 | 8 | 9 | 10 | 11 | 4 | 5 | 6 | 7 | 8 |
| 17 | 18 | 19 | 20 | 21 | 14 | 15 | 16 | 17 | 18 | 11 | 12 | 13 | 14 | 15 |
| 24 | 25 | 26 | 27 | 28 | 21 | 22 | 23 | 24 | 25 | 18 | 19 | 20 | 21 | 22 |
| 31 | | | | | 28 | 29 | 30 | 31 | | 25 | 26 | 27 | 28 | 29 |

**The newsletter is usually mailed out three to four weeks after the deadline.**

# Recent Reports

*You may request a copy of these reports from Kathy Ellington. Fax your request to (510) 486-4089 or email KLEllington@lbl.gov*

## Component-Based and Equation-Based Solvers for HVAC Simulation: A comparison of HVACSIM+ and SPARK*

by
Philip Haves
Lawrence Berkeley National Laboratory
Berkeley, CA 94720
and
Edward F. Sowell
California State University
Fullerton, CA 92834

**Abstract**

A toolkit of component models for HVACSIM+ and TRNSYS, which was designed for use in HVAC control system simulation, has been ported to the SPARK simulation environment. This paper briefly describes the implementation of a selection of these models in the equation-based simulation program SPARK and compares the modeling pro-cess to that used in component-based simulation programs such as HVACSIM+ and TRNSYS.

SPARK uses graph-theoretic techniques to reduce, often significantly, the number of equations that must be solved simultaneously. A comparison of the execution speed of SPARK and HVACSIM+ for a benchmark VAV airflow network control problem performance of a VAV system is presented. The (significant) speed-up observed with SPARK is compared to that expected on the basis of the reduction in the number of equations that are solved simultaneously.

This paper then explores the magnitude of the reduction in the number of simultaneous equations that can be expected for certain types of HVAC system and modeling technique. In particular, the effectiveness of SPARK methods for the efficient simulation of HVAC control systems is addressed.

*Proceedings of System Simulation in Buildings '98, Liege, Belgium, December 1998.

## Energy and Daylight Performance of Angular Selective Glazings*

by
R. Sullivan, L. Beltran, E.S. Lee, M. Rubin
and S. Selkowitz
Building Technologies Department
Environmental Energy Technologies Divison
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

**Abstract**

This paper presents the results of a study investigating the energy and daylight performance of anisotropic angular selective glazings. The DOE-2.1E energy simulation program was used to determine the annual cooling, lighting and total energy use, and peak electric demand. RADIANCE, a lighting simulation program, was used to determine daylight illuminance levels and distribution. We simulated a prototypical commercial office building module in Blythe, CA. Three hypothetical conventional windows were compared: a single-pane tinted window, a double-pane low-E window and a double-pane spectrally selective window. Daylighting controls were used. No interior shades were modeled in order to isolate the energy effects of the angular selective glazing. Results show that the energy performance of the prototype angular selective windows is about the same as conventional windows for a 9.14-m (30-ft) deep south-facing perimeter zone with a large-area window in the hot, sunny climate of Blythe. It is theoretically possible to tune the angular selectivity of the glazing to achieve annual cooling energy reductions of 18%, total electricity use reductions of 15% and peak electric demand reductions of 11% when compared to a conventional glazing with the same solar-optical properties at normal incidence. Angular selective glazings can provide more uniformly distributed daylight, particularly in the area next to the window, for a more visually comfortable work environment.

*Proceedings of Thermal VII, Clearwater Beach, FL, December 1998.

*"Building Loads Analysis and System Thermodynamics"*

# blastnews

## Building Systems Laboratory (BSL)

**30 Mechanical Engineering Building**
**University of Illinois**
**1206 West Green Street**
**Urbana, IL 61801**

**Telephone: (217) 333-3977**
**FAX: (217) 244-6534**
**e-mail: support@blast.bso.uiuc.edu**
**http://www.bso.uiuc.edu**

The **Building Loads Analysis and System Thermodynamics (BLAST)** system is a comprehensive set of programs for predicting energy consumption and energy system performance and cost in buildings. The BLAST system was developed by the U.S. Army Construction Engineering Research Laboratory (USACERL) under the sponsorship of the Department of the Air Force, Air Force Engineering and Services Center (AFESC), and the Department of the Army, Office of the Chief of Engineers (OCE). After the original release of BLAST in December 1977, the program was extended and improved under the sponsorship of the General Services Administration, Office of Professional Services; BLAST Version 2.0 was released in June 1979. Under the sponsorship of the Department of the Air Force, Aeronautical System Division, and the Department of Energy, Conservation and Solar Energy Office, the program was further extended; BLAST Version 3.0 was completed in September 1980. Since 1983, the BLAST system has been supported and maintained by the Building Systems Laboratory at the University of Illinois at Urbana-Champaign.

BLAST can be used to investigate the energy performance of new or retrofit building design options of almost any type and size. In addition to performing peak load (design day) calculations necessary for mechanical equipment design, BLAST also estimates the annual energy performance of the facility, which is essential for the design of solar and total energy equipment design, BLAST also estimates the annual energy performance of the facility, which is essential for the design of solar and total energy (cogeneration) systems and for determining compliance with design energy budgets. Repeated use of BLAST is inexpensive; it can be used to evaluate, modify, and re-evaluate alternate designs on the basis of annual energy consumption and cost.

The BLAST analysis program contains three major subprograms:

- The Space Load Prediction subprogram computes hourly space loads in a building based on weather data and user inputs detailing the building construction and operation.
- The Air Distribution System Simulation sub-program uses the computed space loads, weather data, and user inputs describing the building air- handling system to calculate hot water, steam, gas, chilled water, and electric demands of the building and air-handling system.
- The Central Plant Simulation subprogram uses weather data, results of the air distribution system simulation, and user inputs describing the central plant to simulate boilers, chillers, on-site power generating equipment and solar energy systems; it computes monthly and annual fuel and electrical power consumption.

**Heat Balance Loads Calculator (HBLC)**
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing BLAST input files. HBLC allows the user to visualize the building model as it is developed and modify previously created input files. Within HBLC, each story of the building is represented as a floor plan which may contain several separate zones. Numerous other building details may be investigated and accessed through simple mouse operations. On-line helps provide valuable on-the-spot assistance that will benefit both new and experienced users. HBLC is an excellent tool which will make the process of developing BLAST input files more intuitive and efficient. You can download a demo version of HBLC (for MS Windows) from the BLAST website (User manual included!).

**HBLC/BLAST Training Courses**
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing Experience with the HBLC and the BLAST family of programs has shown that new users can benefit from a session of structured training with the software. Such training helps to define the steps necessary to produce accurate and consistent output from BLAST and its auxiliary programs and gives users a solid foundation from which they can explore the more advanced features of the program with confidence. The Building Systems Laboratory offers such training courses on an as needed basis typically at our offices in Urbana, Illinois and lasting 2 or 3 days depending on the specific needs of the participants. Call the Building Systems Laboratory for additional information on pricing and availability.

**WINLCCID 98**
LCCID (Life Cycle Cost in Design) has been a standard in the DOD community since its initial release in 1986. LCCID was developed to perform Life Cycle Cost Analyses (LCCA) for the Department of Defense and their contractors, yet it goes far beyond being just a DOD study tool by providing many features of a general purpose life cycle costing tool. With LCCID, it's easy to carry out "what-if" analyses based on variables such as present and future costs and/or maintenance and repair costs. LCCID allows an analysis based on standard DOD procedures and annually updated escalation factors as well as Energy Conservation Investment Program (ECIP) LCCA. You can download a demo version of WINLCCID 98 (for MS Windows) from the BLAST website http://www.bso.uiuc.edu [see *User News* Vol. 16, No. 4, p. 5]

**To order BLAST-related products, contact the Building Systems Laboratory at the University of Illinois at Urbana-Champaign. Telephone: (217) 333-3977, FAX: (217) 244-6534, support@blast.bso.uiuc.edu, http://www.bso.uiuc.edu**

**BLAST Order Information**

| Program Name | Order Number | Price Each |
|---|---|---|
| **PC BLAST Package**<br>The standard PC BLAST Package includes the following programs: BLAST, HBLC, BTEXT, WIFE, CHILLER, Report Writer, Report Writer File Generator, Comfort Report program, Weather File Reporting Program, Control Profile Macros for Lotus or Symphony, and the Design Week Program. The programs are provided on a single CD-ROM which also includes soft copies of the BLAST Manual, 65 technical articles and theses related to BLAST, nearly 400 processed weather files with an easy-to-use browsing engine, and complete source code for BLAST, HBLC, and other programs in the BLAST package. Requires an IBM PC 486/Pentium II or compatible running MS Windows 95/98/NT. | 3B486E3-0898 | $1500.00 |
| **PC BLAST Package** Upgrade from level 295+ | 4B486E3-0898 | $450.00 |
| **WINLCCID 98**: executable version for 386/486/Pentium | 3LCC3-0898 | $295.00 |
| **WINLCCID 98**: update from WINLCCID 97 | 4LCC3-0898 | $195.00 |

*The last four digits of the catalog number indicate the month and year the item was released or published. This will enable you to see if you have the most recent version. All software will be shipped on 3.5" high density floppy disks unless noted otherwise.*

# DOE-2 Directory of Program Related Software and Services[1]

## Mainframe/Workstation Versions of DOE-2

| Program Name | Operating System | Description | |
|---|---|---|---|
| **DOE-2.1E**<br><br>From the Energy Science and Technology Software Center (ESTSC) | SUN-4<br>DEC-VAX | Source code, executable code and complete current documentation for:<br><br>DOE-2.1E/Version 094 for SUN-4<br><br>DOE-2.1E DEC-VAX | For a complete listing of the software available from ESTSC, order their "Software Listing" catalog, ESTSC-2. [See *User News* Vol. 16, No. 3, p. 21] |
| **FTI/DOE** (see FTI/DOE listing under PC Versions of DOE-2, below) | | | |

## PC Versions of DOE-2[2]

| Program Name | Operating System | Description |
|---|---|---|
| **ADM-DOE-2**<br><br>Based on<br>J.J. Hirsch DOE-2.1E | DOS<br>Windows 95 | ADM-DOE-2 (DOE-2.1E) is compiled for use on 386/486 PCs with a math co-processor and 4MB of RAM. The package contains everything needed to run the program: program files, utilities, sample input files, and weather files. More than 300 weather files are available (TMY, TRY, WYEC, CTZ formats) for the U.S. and Canada. [See *User News* Vol. 7, No. 2, p. 6] |
| **Compare-IT**<br><br>Based on<br>J.J. Hirsch DOE-2.1E | Windows<br>(98, 95, NT) | Compare-IT allows DOE-2 professionals to add value to their projects by giving clients "what-if" scenarios using DOE-2. The interface is designed for novice energy analysts and the GUI can be customized for each client's particular interests. A tabbed main window is configured based on the user's DOE-2 macro organization. All labels, drop-down list boxes, tool-tips, error checking, and help files are created dynamically from a "Compare-IT-ized" DOE-2 input file. Output are tables and powerful graphs of annual costs, annual energy and end-use and hourly end-use values. [See *User News* Vol. 19, No. 1] |
| **DOE-PLUS**<br><br>Based on<br>J.J. Hirsch DOE-2.1E<br><br>Demo:<br>www.halcyon.com/byrne | DOS<br>Windows<br>(3.1, 95, NT) | Complete support for all DOE-2 commands. Imports BDL files created with a text editor or other program. Interactive error checking. 3-D view of building can be rotated and zoomed. Windows, walls, etc., identified by DOE-2 U-name and allow component editing. User-defined libraries of schedules, HVAC systems, plant equipment, building components, etc. Exports results to spreadsheets and database programs. Graphical display of schedules. Utility programs included: Prep, Demand Analyzer, weather processor. Over 500 worldwide weather files. [See *User News* Vol. 13, No. 2, p. 54, Vol. 16, No. 1, p. 28-32] |
| **EnergyPro**<br><br>Based on<br>ESTSC DOE-2.1E V. 092<br><br>Demo: www.energysoft.com | Windows<br>(95, NT) | Performs nonresidential load calculations for HVAC equipment sizing. Produces typeset quality reports/forms. Electronically exports forms to AutoCad for inclusion on blueprints. On-line help. 344 weather files for the U.S. and Canada.<br>For California Users: Performs Title 24 compliance calculations, includes state-certified HVAC and DHW Equipment directories, Title 24 tailored lighting calculations.<br>[See *User News* Vol. 18, Nos. 2, 4] |
| **EZDOE**<br><br>Based on<br>J.J. Hirsch DOE-2.1D<br><br>Demo: www.elitesoft.com | DOS | Provides full screen, fill-in-the-blank data entry, dynamic error checking, context-sensitive help, mouse support, graphic reports, a 750-page user manual, and extensive weather data. EZDOE integrates the full calculation modules of DOE-2 into a powerful, full implementation of DOE-2 on DOS-based 386 and higher computers. On-line help. Includes some weather files. *[See User News Vol. 14, No. 2, p. 10 and No. 4, p. 8-14]* |
| **FTI/DOE**<br><br>Based on<br>ESTSC DOE-2.1E V. 092<br><br>No demo, 30-day trial period | DOS<br>Windows<br>(3.x, 95, NT)<br>AIX, ULTRIX, VMS, Linux, NeXTStep, | FTI/DOE is 100% compatible with LBNL version. Highly optimized and extremely reliable. Version 3.1 will include a graphical user interface and will provide full command functionality and access to all reporting features of the original. Interface is Java-based and will be available for any system supporting Java. Source code versions will compile with most F77-compliant compilers. On-line help: Yes for Version 3.x, No for Version 2.x. 344 weather files for the U.S. and Canada. *[See User News Vol. 12, No. 4, p. 16]* |
| **PRC-DOE-2**<br><br>Based on<br>J.J. Hirsch DOE-2.1E<br><br>No demo | DOS<br>Windows<br>(95, NT) | This text-based version of DOE-2 is fast, reliable, and very up to date. Documentation includes 2.1E Supplement, 2.1E BDL Summary; original Reference Manual available. Extensive information on new features is included on the disk as well, including information on new system types, new commands, new options, etc., added to later versions of 2.1E. |

[1] Information based on a December 1997 survey of DOE-2 product vendors. We list third-party DOE-2-related products and services for the convenience of program users, with the understanding that the Simulation Research Group does not have the resources to check the DOE-2 program adaptations and utilities for accuracy or reliability.

[2] Note: the MicroDOE2 program is no longer available.

# DOE-2 Directory of Program Related Software and Services

## Mainframe/Workstations Versions of DOE-2

| Input<br>Output | Support | Program Price | Vendor Information |
|---|---|---|---|
| | Limited "operational" support, which includes telephone assistance concerning installation, media or platform questions. | SUN version: Govt/Educ $400<br>U.S., Mexico, Canada $1305<br>Other Foreign $2000<br>VAX version: Govt/Educ $500<br>U.S., Mexico, Canada $1835<br>Other Foreign $2716 | **Energy Science & Tech Software Center**<br>P.O. Box 1020<br>Oak Ridge, TN 37831-1020<br>Ph: 423-576-2606 / Fx: 423-576-2865<br>ESTSC@ADONIS.OSTI.GOV<br>www.doe.gov/html/osti |
| **FTI/DOE** (see FTI listing under PC Versions of DOE-2, below) | | | |

## PC Versions of DOE-2

| Input<br>Output | Support | Program Price | Vendor Information |
|---|---|---|---|
| No information given<br>No information given | None | $395 + $15/SH including one set weather data (your choice) and documentation | **ADM-DOE- 2** **(Richard Burkhart)**<br>ADM Associates adm_asc@ns.net<br>3239 Ramos Circle<br>Sacramento, CA 95827-2501<br>Ph: 916-363-8383 / Fx: 916-363-1788 |
| Customizable windows GUI dynamically built based on DOE-2 macros.<br>Tables and graphs exportable to MS Excel 97. Custom reports dynamically generated in Word 97. | Support price is negotiable; online help included with the program. | $500 consultant<br>$2000 client<br><br>Documentation available | **Compare-IT** **(Ed Erickson)**<br>RLW Analytics<br>1055 Broadway, Suite G<br>Sonoma, CA 95476<br>Ph: 707-939-8823 / Fx: 707-939-9218<br>Info@rlw.com or www.rlw.com |
| Interactive, graphical, fill-in-the-blanks<br>Customizable tables and graphics | Unlimited, except for DOE-2 modeling advice.<br>On-line help. | $895 with DOE-2 and doc<br><br>$495 without DOE-2<br><br>Source code not available. | **DOE-Plus** **(Steve Byrne)**<br>Item Systems<br>321 High School Road NE #344<br>Bainbridge Island, WA 98110<br>Ph: 206-855-9540 / Fx: 206-855-9541<br>byrne @ item.com |
| Graphical<br>Graphs, forms | Unlimited support | DOE-2 Module:<br>Non-residential $ 700[1,2]<br>Residential $ 250[1,2]<br>Program Interface $ 195[3]<br>[1] price reflects cash discount<br>[2] includes documentation<br>[3] required | **EnergyPro** **(Demian Vonderkulen)**<br>Gabel Dodd/EnergySoft LLC<br>100 Galli Drive #1<br>Novato, CA 94949-5657<br>Ph: 415-883-5900 / Fx: 415-883-5970<br>demian@energysoft.com |
| Fill-in-the-blanks<br>Standard DOE reports plus some custom graphic reports | Unlimited phone support | $1295 w/documentation<br><br>Source code not available. | **EZDOE** **(Bill Smith)**<br>Elite Software<br>P.O. Box 1194<br>Bryan, TX 77806<br>Ph: 409-846-2340 / Fx: 409-846-4367<br>bsmith @ elitesoft.com |
| Version 2.x: text based<br>Version 3.x: graphical<br>All standard DOE-2 reports<br><br>Run time and status graphics | Free support for 90 days from date of purchase.<br>After 90 days, support is:<br>$35 email per incident<br>$55 hour per incident<br>$125 per hour for engineering advice. Bugs reports free. | $ 995.99 US w/documentation<br>$1066 Int'l w/documentation<br>$4999.99 source code | **FTI/DOE2** **(Scott A. Henderson)**<br>Finite Technologies Inc.<br>3763 Image Drive<br>Anchorage, Alaska 99504<br>Ph: 907-333-8937 / Fx: 907-333-4482<br>info @ finite-tech.com |
| Standard text-based | Unlimited support. | $ 495 w/documentation<br><br>Source code not available. | **PRC-DOE-2** **(Paul Reeves)**<br>Partnership for Resource Conservation<br>140 South 34th Street<br>Boulder, CO 80303<br>Ph: 303-499-8611 / Fx: 303-554-1370<br>Paul.Reeves@DOE2.com |

Continued on next page

# DOE-2 Directory of Program Related Software and Services (continued)

## PC Versions of DOE-2 (continued)

| Program Name | Operating system | Description |
|---|---|---|
| **VisualDOE2.6**<br><br>Based on<br>J.J. Hirsch DOE-2.1E, V. 083<br><br>Demo: www.eley.com | DOS<br>Windows<br>(3.1, 95, NT) | Dramatically faster construction of building geometry using pre-defined blocks and/or drawing interface. Import zone shapes from CADD file (dxf format). Point-and-click to define zone properties and HVAC systems. Define up to 20 design alternatives in each project file. View rotatable 3-D image of model. Create custom hourly output reports and customized graphs. Edit and expand library of constructions, schedules, equipment, and utility rates. Add custom performance curves. Network version allows sharing of libraries. On-line help. 400+ weather files for the U.S., 12+ weather files for Canada, plus selected locations around the world. *[See User News Vol. 15, No. 2, p. 10; Vol. 16, No. 4, p. 9-16; Vol. 17, No. 4, p. 8-13]* |

## Pre- and Post-Processors for DOE-2

| Program Name | Description |
|---|---|
| **DrawBDL** | **DrawBDL,** Version 2.02, is a graphic debugging and drawing tool for DOE-2 building geometry. DrawBDL reads your BDL input and makes a rotate-able 3-D drawing of your building with walls, windows, and building shades shown in different colors for easy identification. *[See User News, Vol. 14, No. 1, p. 5-7, Vol. 14, No. 4, p. 16-17, and Vol. 16, No. 1, p.37]* |
| **Visualize-IT**<br>(Visual Data Analysis Tools) | The ***Energy Information Tool*** is used to review and understand metered or DOE-2.1E hourly output data. It provides the ability to see all 8760 (or 35040) data points for a year's worth of data. Use *Energy/Print* to get an overview of the data and then apply a variety of tools (load shapes, load duration curves, etc.). The ***Calibration Tool*** compares DOE-2.1E hourly output data to total load and/or end-use metered data. Options include monthly demand and load 2D graphs, maximum and seasonal load shapes, average load profiles, end use residuals, monthly average week and weekend days, and dynamic comparison load shapes. Both programs requires a 486 or higher computer and SVGA graphics capabilities. *[See User News Vol. 17, No. 2, p. 2-6]* |
| **PRC-TOOLS:**<br>**PRC-Grab**<br>**PRC-Hour**<br>**PRC-Peak** | ***PRC-Tools*** aid in extracting, analyzing, and formatting DOE-2 output. ***PRC-Grab*** automates the process of extracting any number of answers from DOE-2 standard output files. ***PRC-Hour*** and ***PRC-Peak*** format the hourly output and create Peak-Day and Average-Day load shapes for any number of periods and for any combination of hourly values. |

## Special Versions of DOE-2

| Program Name | Description |
|---|---|
| **DesiCalc**<br><br>No demo | DesiCalc, from the Gas Research Institute, screens desiccant cooling applications. It estimates annual or monthly energy loads, using hour-by-hour simulations, and costs for 11 typical commercial buildings in 236 geographical locations in the United States. The tool uses electrical equipment from a library of five typical systems and compares the performance of any of the systems with an alternative configuration, the chosen electric system supplemented with a desiccant dehumidifier. Includes the latest TMY2 meteorological database |
| **Energy Gauge USA**<br>**(Residential DOE-2)** | *Energy Gauge USA* allows the simple calculation and rating of residential building energy use in the United States. The simulation calculates a six-zone model of the residence (conditioned zone, attic, crawlspace, basement, garage and sunspace) with the various buffered spaces linked to the interior as appropriate. TMY weather data for the program are available for 213 locations around the U.S. |
| **Home Energy Saver**<br>**(Residential DOE-2)**<br>Free, interactive, Web-based program | The *Home Energy Saver* (HES) is designed to help consumers identify the best ways to save energy in their homes, and find the resources to make the savings happen. The HES calculates heating and cooling consumption using DOE-2.1E. The program performs a full annual simulation for a typical weather year (involving 8760 hourly calculations) from 239 locations around the United States in about 10-20 seconds. |
| **Perform-95** | Created for the State of California Energy Commission's, Title 24 energy code. Perform-95 is an interface shell with DOE-2 as the engine. Standard text-based input. Output is only California Title 24 compliant. Technical support available for $100/year from Gabel-Dodd Energy Soft LLC, 100 Galli Drive #1, Novato, CA 94960. Call 415-883-5900 for details. |
| **RESFEN-3.0**<br><br>No demo | RESFEN calculates the energy and cost implications of a building's windows compared to insulated walls. The relative energy and cost impacts of two different windows can also be compared against each other. RESFEN calculates the heating and cooling energy use and associated costs as well as the peak heating and cooling demand for specific window products. Users define a problem by specifying the house type (single story or two story), geographic location, orientation, electricity and gas cost, and building configuration details (such as wall type, floor type, and HVAC systems). Window options are defined by specifying the window's size, shading, and thermal properties: U-factor, Solar Heat Gain Coefficient, and air leakage rate. |

# DOE-2 Directory of Program Related Software and Services

## PC Versions of DOE-2 (continued)

| Input / Output | Support | Program Price | Vendor Information |
|---|---|---|---|
| Graphical | 90 days free phone and email support.<br><br>Support is $195 per year after first 90 days | $495 w/documentation<br><br>Source code not available. | **VisualDOE2.6 (C. Eley or Erik Kolderup)**<br>Charles Eley Associates<br>142 Minna Street<br>San Francisco, CA 94105<br>Ph: 415-957-1977 / Fx: 415-957-1381<br>support@eley.com |
| Graphical | | | |

## Pre- and Post-Processors for DOE-2

| Operating System | Version of DOE-2 | Price | Vendor |
|---|---|---|---|
| Windows 3.1, 95, NT | DOE-2.1E | $125.00<br>plus shipping | **Joe Huang & Associates**<br>6720 Potrero Avenue<br>El Cerrito, CA 91364<br>Ph/Fx: 510-236-9238 |
| Windows 3.1 | DOE-2.1E | | **RLW Analytics, Inc. (Ed Erickson)**<br>1055 Broadway, G<br>Sonoma, CA 95476<br>Ph: 707-939-8823<br>Fx: 707-939-9218<br>Info@rlw.com / www.rlw.com |
| Windows 95, NT | DOE-2.1E | $99.00 | **Partnership for Resource Conservation**<br>140 South 34th Street **(Paul Reeves)**<br>Boulder, CO 80303<br>Ph: 303-499-8611 / Fx: 303-554-1370<br>Paul.Reeves@DOE2.com |

## Special Versions of DOE-2

| Operating System | Based on this version of DOE-2 | Price | Vendor |
|---|---|---|---|
| Windows 3.1, 95, 98, NT | DesiCalc is an overlay of DOE-2.1E and contains the complete DOE-2.1E program. It also contains the complete TMY2 data set. | $295 including documentation<br>+8.75% tax in IL<br>+4.5% tax in VA<br>S/H $20 | **DesiCalc GRI-98/0127 (Doug Kosar)**<br>Order from:<br>GRI Fulfillment Center<br>Ph: 773-399-5414<br>Fx: 630-406-5995 |
| Windows 95, 98, NT | DOE-2.1E | Contact Danny Parker at FSEC for availability. | **Energy Gauge USA (Danny Parker)**<br>Florida Solar Energy Center<br>1679 Clearlake Road<br>Cocoa, FL 32922<br>Ph: 407-638-1405 /Fx: 407-638-1439 |
| Web-based | DOE-2.1E | free | **Home Energy Saver**<br>interactive program at<br>http://eande.lbl.gov/CBS/VH |
| DOS | DOE-2.1E | $250 including Perform-95 manual.<br><br>Order #P440-96-0006 | **California Energy Commission**<br>Publications MS-13<br>P.O. Box 944295<br>Sacramento, CA 94244-2950<br>Contact the Energy Hotline (in California, call 800-772-3300) at Ph: 916-654-5106 |
| | DOE-2.1E | free | **RESFEN-3.1**<br>Fax: (510) 486-4089 or mail your request to:<br>Windows & Daylighting Group<br>MS 90-3111<br>Lawrence Berkeley National Laboratory<br>Berkeley, CA 94720 |

# INTERNATIONAL DOE-2 RESOURCE CENTERS

*The people listed here have agreed to be primary contacts for DOE-2 program users in their respective countries. Each resource center has the latest program documentation, all back issues of the User News, and recent LBNL reports pertaining to DOE-2. These resource centers will receive copies of all new reports and documentation. Program users can then make arrangements to get photocopies of the new material for a nominal cost. We hope to establish resource centers in other countries; please contact us if you are interested in establishing a center in your area.*

**Australasia**

Dr. Deo K. Prasad/P. C. Thomas, SOLARCH, University of New South Wales, P.O. Box 1, Kensington, N.S.W. 2033, Australia email PC.Thomas@unsw.EDU.AU / Tel: (61)-2-9311-7136 (P.C. Thomas) / Fax: (61) 2-9662-1378

**Australia**

Murray Mason, ACADS BSG, 16 High Street, Glen Iris VIC. 3146, Australia / Tel: (61) 885 6586 / Fax: 885 5974

**Egypt**

Dr. Ossama A. Abdou, Center for Building Environmental Studies and Testing (C-Best), 15-El-Shibani Street, Almanza, Cairo, Egypt oabdou@hotmail.com / Tel: (20-2) 391-1137 or 417-4583 / Fax: 519-4343

**Germany**

B. Barath or G. Morgenstern, Ingenieurbüro Barath & Wagner GmnH, Postfach 20 21 41, D-41552 Kaarst, Germany Tel: (0049) 2131 75 74 90 12 G. Morgenstern / Fax: (0049) 2131 75 74 90 29

**Hong Kong, China, Taiwan, Japan**

Dr. Sam Chun-Man HUI or K.P. Cheung, Department of Architecture, The University of Hong Kong, Pokfulam Road, Hong Kong (SAR), CHINA / cmhui@hku.hk / http://arch.hku.hk/research/BEER/DOE-2/DOE-2.htm Tel: (852) 2123 (direct to Sam Hui) / Fax: (852) 2559-6484 / Hui pager 7116 3808 a/c 1830

**Korea (Chungnam)**

Dr. Jun Tae KIM, Room #114 New Engineering Building, Department of Architectural Engineering, Faculty of Engineering, Kong Ju National University, 182 Sinkwan-dong, Kongju, Chungnam, 314-701, Republic of Korea / jtkim@knu.kongju.ac.kr / Tel: (82) 416 50 8653 / Fax (82) 416 856 9388

**Korea (Taejon)**

Dr. Euy-Joon Lee and Jong-Ho Yoon, Passive Solar Research Team, Building 2 / Room 202, Korea Institute of Energy Research (KIER), Daeduk Science Town, 71-2 Jang-Dong, Yusong-Gu, Taejon 305-343, Republic of Korea Lee: ejlee@kier.re.kr, Yoon: yesru@kier.re.kr / Tel: (82) 42 860 3514 / Fax: (82) 42 860 3132

**New Zealand**

Tan Yune, Architecture Department, The University of Auckland, Private Bag 92019, Auckland, New Zealand tanyune@ccu1.auckland.ac.nz / Tel: 64-9-373-7999 x5647 / Fax: 64-9-373-7410

**Portugal, Spain, Italy, and Greece**

Antonio Rego Teixeira, ITIME, Unidade de Energia, Estrada do Paco do Lumiar, 1699 Lisboa, Portugal art@itime.ineti.pt / Tel: (351) 1-350-29 31 / Fax: (351) 1-716-43 05

**Singapore, Malaysia, Indonesia, Thailand, and the Philippines**

WONG Yew Wah, Raymond, Nanyang Technological University, School of Mechanical and Production Engineering, Nanyang Avenue, Singapore 2263, Republic of Singapore, mywwong@ntu.edu.sg / Tel: (65) 790-5543 / Fax: (65) 791-1859

**South Africa**

Prof. L. J. Grobler, School of Mechanical and Materials Engineering, University of Potchefstroom, Private Bag X6001, Potchefstroom 2520, South Africa mgiljg@puknet.puk.ac.za / Tel: (27 148) 299 1328 / Fax: (27 148) 299 1320

**South America**

Prof. Roberto Lamberts,Universidade Federal de Santa Catarina, Campus Universitario-Trindade, Cx. Postal 476, 88049-900 Florianopolis SC, BRASIL lamberts@ecv.ufsc.br / Tel: + 55 48 3319272/ Fax: + 55 48 3319770

**Switzerland**

René Meldem, Meldem Energie SA, 30 a ch. de la Fauvette, CH-1000 Lausanne 12, Switzerland meldem.energie@bluewin.ch / Tel: +41 21 653-8044 / Fax: +41 21 653-8054

# INTERNATIONAL DOE-2 ENERGY CONSULTANTS

**Belgium**

Andre Dewint, rue de Livourne 103/12, B-1050 BRUXELLES Belgium

**Canada**

Curt Hepting, P.Eng. EnerSys Analytics, 2989 Delahaye Drive, Coquitlam, B.C. V3B 6Y9 Canada enersys@infoserve.net / www.enersys.bc.ca/homepage / Tel: (604) 552-0700 / Fax (604) 552-0713

Dejan Radoicic, D. W. Thomson Consultants, Ltd., 1985 West Broadway, Vancouver, BC V6J 4Y3, Canada

Neil A. Caldwell, PE, DukeSolutions Canada, Inc., 1730 - 401 West Georgia St., Vancouver, BC V6B 5A1 Canada ncaldwe@duke-energy.com

Stephane Bilodeau, PE, Groupe Enerstat, Inc., 79 Wellington N. #202, Sherbrooke (Quebec) J1H 5A9, Canada bill@aramis.gme.usherb.ca / Tel: (819) 562-8040 / Fax (819) 562-5578

Gordon Shymko, G.F. Shymko & Associates, Inc., 202-1738 Alberni Street, Vancouver, BC V6G 1B2 Canada gshymko@direct.ca / Tel: (604) 685-5350 / Fax: (604) 685-5301

**Germany**

Jens Grundt and Ludwig Michel, GMW-Ingenieurburo, Vahrenwalder Str. 7, D-30165 Hannover, Germany GMW-Ing.buero@t-online.de / Tel: 0049-511 9357440/Fax 0049-511-935744

**New Zealand**

Paul Bannister Energy Group, Ltd., 14a Wickliffe Street (P.O. Box 738), Dunedin New Zealand eglstaff@earthlight.co.nz

**Switzerland**

René Meldem, Meldem Energie SA, 30 a ch. de la Fauvette, CH-1000 Lausanne 12, Switzerland meldem.energie@bluewin.ch / Tel: +41 21 653-8044 / Fax: +41 21 653-8054

Philip Schluchter, Institut fur Bauphysik Klein, Urs Graf-Strasse 1, CH4052 Basel, Switzerland

Gerhard Zweifel, Zentralschweizerisches Technikum Luzern (ZTL), Abt. HLK, CH-6048 Horw, Switzerland gzweifel@ztl.ch

Markus Koschenz, Building Equipment Section 175, EMPA, 129 Überlandstrasse, CH-8600 Dübendorf, Switzerland

**DOE-2.1E Bug Fixes via FTP**

If you have Internet access you can obtain the latest bug fixes to the LBNL version of DOE-2.1E by anonymous ftp. Here's how…

ftp to either gundog@lbl.gov or to 128.3.254.10
login: *type* anonymous
password: *type in your e-mail address*

After logging on, go to directory pub/21e-mods ; bug fixes are in files that end with **.mod** . A description of the fixes is in file **VERSIONS.txt** in directory **pub** . Each fix has its own version number, ***nnn*** , which is printed out as DOE-2.1E- *nnn* on the DOE-2.1E banner page and output reports when the program is recompiled with the fix. You may direct questions about accessing or incorporating the bug fixes to Ender Erdem (aeerdem@lbl.gov).

## U. S. DOE-2 ENERGY CONSULTANTS

| | | | | |
|---|---|---|---|---|
| **Arizona** | | | | |
| Marlin S. Addison | M. S. Addison & Associates | 1215 West 12th Place | Tempe, AZ 85281 | (602) 968-2040 |
| Chuck Sherman | Energy Simulation Specialists | 64 East Broadway, #230 | Tempe, AZ 85282 | (602) 784-4500 |
| Sarat Kanaka | EcoGroup, Inc., Suite 301 | 2085 E. Technology Circle | Tempe, AZ 85284 | (602) 777-3000 |
| **California** | | | | |
| M. Gabel, R. Howley | Gabel Associates, LLC | 1818 Harmon Street | Berkeley, CA 94703 | (510) 428-0803 |
| George Marton | 1129 Keith Avenue | | Berkeley, CA 94708 | (510) 841-8083 |
| Jeff Hirsch | James J. Hirsch Associates | 12185 Presilla Road | Camarillo, CA 93012 | (805) 532-1045 |
| John R. Aulbach, PE | 23508 Naffa Avenue | | Carson, CA 90745 | (310) 549-7118 |
| Leo Rainer | Davis Energy Group, Inc. | 123 C Street | Davis, CA 95616 | (916) 753-1100 |
| L. Heshong, D. Mahone | The Heshong Mahone Group | 11626 Fair Oaks Blvd, #302 | Fair Oaks, CA 95628 | (916) 962-7001 |
| Cliff Gustafson | Taylor Systems Engrg. Inc. | 9801 Fair Oaks Blvd., #100 | Fair Oaks, CA 95628 | (916) 961-3400 |
| Steven D. Gates, PE | 11608 Sandy Bar Court | | Gold River, CA 95670 | (916) 638-7540 |
| Tom Lunneberg, PE | Constructive Tech. Group | 16 Technology Dr., #109 | Irvine, CA 92618 | (714) 790-0010 |
| David J. Schwed | Romero Management Assoc | 1805 West Avenue K | Lancaster, CA 93534 | (805) 940-0540 |
| Robert E. Gibeault | A-TEC | 5515 River Avenue, # 301 | Newport Beach, CA 92663 | (714) 548-6836 |
| Martyn C. Dodd | Gabel Dodd/EnergySoft, LLC | 100 Galli Drive, # 1 | Novato, CA 94949 | (415) 883-5900 |
| Robert Mowris, PE | Robert Mowris & Associates | 10 Ridge Lane | Orinda, CA 94563 | (925) 254-9770 |
| Patrick Nkwocha, PE | Global Tech Services | 3360 Foothill Blvd., #108 | Pasadena, CA 91107 | (626) 583-8205 |
| James Trowbridge, PE | Trowbridge Engineering | 8240 Caribbean Way | Sacramento, CA 95826 | (916) 381-4753 |
| Greg Cunningham | EnerSys Solutions LLC | 114 Sansome St., #1201 | San Francisco, CA 94104 | (415) 296-9760 |
| Charles Eley, T. Tathagat | Eley Associates | 142 Minna Street | San Francisco, CA 94105 | (415) 957-1977 |
| John F. Kennedy, PE | GeoPraxis, Inc. | 18850 Robinson Road | Sonoma, CA 95476 | (707) 996-9408 |
| Chandra Shinde, PE | ENVIRODESIGN GROUP | 385 S. Lemon Ave., E-266 | Walnut, CA 91789 | (909) 598-1980 |
| **Colorado** | | | | |
| Fred Porter | Architectural Energy Corp | 2540 Frontier Ave, #201 | Boulder, CO 80301 | (303) 444-4149 |
| Paul Reeves | PRC | 140 South 34th Street | Boulder, CO 80303 | (303) 499-8611 |
| Ellen Franconi | P.O. Box 1284 | | Boulder, CO 80306 | (303) 786-7319 |
| Charles Fountain | Burns & McDonnell | 8055 E. Tufts Avenue, #330 | Denver, CO 80230 | (303) 721-9292 |
| Susan Reilly | Enermodal Engineering | 1554 Emerson Street | Denver, CO 80218 | (303) 861-2070 |
| Joel Neymark, PE | 2140 Ellis Street | | Golden, CO 80401 | (303) 384-3672 |
| Norm Weaver, PE | Interweaver Consulting | P.O. Box 775444 | Steamboat Spgs, CO 80477 | (970) 870-1710 |
| **Connecticut** | | | | |
| Adrian Tuluca | Steven Winter Associates | 50 Washington Street | Norwalk, CT 06854 | (203) 852-0110 |
| **District of Columbia** | | | | |
| Kurmit Rockwell, PE | XENERGY, Inc., Suite 1110 | 1025 Connecticut Ave., N.W. | Washington, DC 20036 | (202) 872-1626 |
| **Florida** | | | | |
| Philip Wemhoff | 1512 South McDuff Avenue | | Jacksonville, FL 32205 | (904) 632-7393 |
| Dr. Paul Hutchins PE,CEM | Reynolds Smith & Hills, Inc. | 4651 Salisbury Road | Jacksonville, FL 32256 | (904) 279-2277 |

## U. S. DOE-2 ENERGY CONSULTANTS (continued)

| | | | | |
|---|---|---|---|---|
| **Georgia** | | | | |
| Lung-Sing Wong, PE | Building Performance Engrs. | 1351 Oakbrook Dr., #100 | Norcross, GA 30093 | (770) 409-0400 |
| **Illinois** | | | | |
| Michael P. Doerr | Skidmore Owings Merrill | 224 S Michigan Ave # 1000 | Chicago, IL 60604 | (312) 360-4623 |
| Gary H. Michaels, PE | G.H. Michaels Associates | 1512 Crain Street | Evanston, IL 60202 | (847) 869-5859 |
| Prem N. Mehrotra | General Energy Corp. | 230 Madison Street | Oak Park, IL 60302 | (708) 386-6000 |
| Robert Henninger, PE | GARD Analytics, Inc. | 1028 Busse Highway | Park Ridge, IL 60068-1802 | (847) 698-5686 |
| **Kansas** | | | | |
| Dr. Brian A. Rock, PE | A/E Dept, Marvin Hall | University of Kansas | Lawrence, KS 66045-2222 | (785) 864-3603 |
| **Massachusetts** | | | | |
| Michael Andelman | JRMA & Associates | 421 Watertown St. | Boston, MA 02210 | (617) 964-8889 |
| C. Kalasinsky PE, T.Chan | R.G. Vanderweil Engrs., Inc. | 274 Summer Street | Newton, MA 02458-1113 | (617) 423-7423 |
| Mark Mullins | DMI, Inc. | 450 Lexington Street | Newton, MA 02466 | (617) 527-1525 |
| **Missouri** | | | | |
| Mike Roberts | Roberts Engineering Co. | 11946 Pennsylvania | Kansas City, MO 64145 | (816) 942-8121 |
| Bruce A. Leavitt, PE | Wm. Tao & Associates Inc. | 2357-59th Street | St. Louis, MO 63110 | (314) 644-1400 |
| **Montana** | | | | |
| Michael W Harrison, PE | Harrison Engineering | 139 Bluebird Lane | Whitehall, Montana 59759 | (406) 287-5370 |
| **Nebraska** | | | | |
| Philip M. Schreier, PE | Farris Engineering | 11239 Chicago Circle | Omaha, NE 68154-2634 | (402) 330-5900 |
| **New York** | | | | |
| J. Fireovid, K. Yousef | SAIC Energy Solutions Div. | 1 Marcus Boulevard | Albany, NY 12205 | (518) 458-2249 |
| H. Henderson, S. Carlson | CDH Energy Corporation | P.O. Box 641 | Cazenovia, NY 13035 | (315)-655-1063 |
| Dave Pruitt, Scott Frank | Jaros, Baum & Bolles | 80 Pine Street | New York, NY | (212) 530-9300 |
| **North Carolina** | | | | |
| Hank Jackson, PE | P.O. Box 675 | | Weaverville, NC 28787-0675 | (828) 658-0474 |
| Gopal Shiddapur, PE | DukeSolutions (MC: ST05A) | 230 S. Tryon Street, # 400 | Charlotte, NC 28202 | (704) 373-4439 |
| **Oregon** | | | | |
| J. Karasaki, PE, R. Ogle PE | CBG Consulting Engineers | 6650 SW Redwood Ln, #355 | Portland, OR 97224 | (503) 620-3232 |
| **Texas** | | | | |
| Jeff S. Haberl | Energy Systems Laboratory | Texas A&M University | College Stn., TX 77843-3123 | (409) 845-6065 |
| **Virginia** | | | | |
| Dave Walker | Walker Engineering | P.O. Box 366 | Staffordsville, VA 24167 | (540) 921-4544 |
| **Washington** | | | | |
| Steve Byrne | ITEM Systems, suite 344 | 321 High School Road NE | Bainbridge Island, WA 98110 | (206) 855-9540 |
| Gregory J. Banken, PE. | Q-Metrics, Inc. | P.O. Box 3016 | Woodinville, WA 98072-3016 | (425) 825-0200 |

# Meetings, Conferences, Symposia

**ASHRAE Annual Meeting**

To be held
June 19-23, 1999 in Seattle, WA

Contact:
ASHRAE Meetings Section1
791 Tullie Circle NE,
Atlanta, GA 30329
Tel: 404.636.8400 / Fax: 404.321.5478
jyoung@ashrae.org / www.ashrae.org

**ACEEE Summer Study on Energy Efficiency in Industry**

To be held
June 15-18, 1999 in Saratoga Springs, NY

Contact:
1999 ACEEE Summer Study Office
1001 Connecticut Ave., N.W. #801
Washington, DC 20036
Tel: 202.429.8873 / Fax: 202.429.2248
conf@aceee.org / www.aceee.org

**International Building Performance Simulation Association (IBPSA)**

**Building Simulation '99**

**To be held September 13-15, 1999 in Kyoto, Japan**

**Contact**

Masaya Okumiya -- CIRSE
Nagoya University
Furo-cho, Chikusa-ku,
Nagoya 464-8603 Japan
Fax: +81-52-789-5318
e-mail BS99@archi.kyoto-u.ac.jp


## *What's New ?* *(continued from P. 1)*

❖ **New Reader Services ...**

A new category has been added to the DOE-2 Directory of Software and Services. Look for ***Specialized Versions of DOE-2*** on p. ___. There is also a listing of LBNL software available for (mostly) beta testing. See p. ___.

❖ **New DOE-2 Consultant ...**

Philip Schreier of Farris Engineering, consulting engineers in Omaha, Nebraska, is our newest DOE-2 consultant:

**Philip M. Schreier, P.E.**
**Farris Engineering**
**11239 Chicago Circle**
**Omaha, NE 68154-2634**
**Tel: 402.330-5900**
**Fax: 402.330-5902**
**Email: FEI-OMA@worldnet.att.net**

❖ **DOE-2.2 Release Postponed ...**

The release of DOE-2.2, which had been announced for the Summer of 1998, has been postponed until a cross license agreement between LBNL and program co-author, Hirsch & Associates, can be finalized.

❖ **On the Move ...**

**Geopraxis**, DOE-2 consultants, energy engineers and software developers, has moved. Their new address is

**GeoPraxis**
**461 - 7th Street West, Suite 1**
**Sonoma, CA 95476-5976**
**Tel: 707.996.9408**
**Fax: 707.939.8702**
**www.geopraxis.com**

# WEATHER DATA SOURCES

| | |
|---|---|
| **BinMaker: The Weather Summary Tool (www.BinMaker.com)**<br>From the Gas Research Institute, BinMaker is a CD-ROM based program that runs under Windows 95 or 3.1. It allows you to create summaries of U.S. hourly weather data (TMY2) then exports the results into spreadsheets or other analysis programs. Cost is $59.95 + $9.00 shipping (with a discount to GRI members). | Order No. GRI/98-0026<br>GRI Fulfillment Center<br>1510 Hubbard Drive<br>Batavia, IL 60510<br>Phone: (773) 399-5414 / Fax (630) 406-5995<br>Email: Fillit@compuserve.com |
| **DOE-2-Processed Versions of all TMY2** files for PC implementation (except CEARE) | ftp://anonymous:weather@gundog.lbl.gov/pub/JJHTMY2.zip |
| Comprehensive collection of **TRY**, **TMY** and **CTZ** weather file libraries, from NCDC, which can be used on all PC versions of DOE-2. Includes original source data and pre-formatted packed versions on a single IBM format CD. Individual sites available. | Jennie Lathum or Martyn Dodd<br>Gabel Dodd / EnergySoft, LLC<br>100 Galli Drive, Suite 1<br>Novato, CA 94949<br>Phone: (415) 883-5900 / Fax: (415) 883-5970 |
| **European** Weather Files | Andre Dewint<br>Alpha Pi, s.a.<br>rue de Livourne 103/12<br>B-1050 BRUXELLES, Belgium<br>Phone: 32-2-649-8359 / Fax: 32-2-649-9437 |
| **TMY** data sets - download from the World Wide Web<br>**TMY2** data sets and **TMY2 User Manual** - download from the World Wide Web<br>[See *User News* Vol. 18, no. 2, p. 17] | TMY: http//oipea-www.rutgers.edu/html_docs/TMY/tmy.html<br><br>TMY2: http://rredc.nrel.gov/solar/ |
| **TMY** (Typical Meteorological Year)<br>**TRY** (Test Reference Year) | National Climatic Data Center<br>151 Patton Avenue, #120<br>Asheville, NC 28801<br>Phone: (704) 271-4871 order Fax 271-4876 |
| **CTZ** (California Thermal Climate Zones) | California Energy Commission<br>Bruce Maeda, MS-25<br>1516-9th Street<br>Sacramento, CA 95814-5512<br>1-800-772-3300 Energy Hotline |
| **WYEC** (Weather Year for Energy Calculation) | ASHRAE<br>1791 Tullie Circle N.E.<br>Atlanta, GA 30329<br>Phone: (404) 636-8400 / Fax: (404) 321-5478 |
| **Canadian Weather Files in WYEC2 Format** | Dr. Didier Thevenard<br>Numerical Logics, Inc.<br>119 University Avenue East, 3rd Floor<br>Waterloo, ON N2J 2W1, Canada<br>Phone: (519) 886-7820 / Fax: (519) 747-0881<br>www3.sympatico.ca/numlog<br>numlog@sympatico.ca |

# ***DOE-2.1E Documentation for International Users***

*(except Canada and Mexico)*

The National Technical Information Service (NTIS) is the central resource for government-sponsored U.S. and world-wide scientific, technical, engineering, and business-related information. It is self-supporting and covers its operating expenses through product sales. NTIS has arrangements with cooperating organizations throughout the world to provide information on new and existing products and services, to process orders, resolve order-related problems, coordinate and accept payment in local currency, and clear orders through the local Customs office. If you live in a country that is not listed below, contact the agency nearest you. You may order by document name or order number (listed below).

| Document Name | Order Number | Document Name | Order Number |
|---|---|---|---|
| DOE-2 Basics Manual (2.1E) | DE-940-13165 | Reference Manual (2.1A) | LBL-8706, Rev.2 |
| BDL Summary (2.1E) | DE-940-11217 | Supplement (2.1E) | DE-940-11218 |
| Sample Run Book (2.1E) | DE-940-11216 | Engineers Manual (2.1A) [algorithm descriptions] | DE-830-04575 |

AUSTRALIA
Fairfax RESEARCH
Overseas Document Service
Level 25, Darling Park
201 Sussex St.
Sydney 2000, AUSTRALIA
sgoddard@fairfax.com.au
Tel: 61-2 9282-1614 / Fax: -3656

DENMARK
IHS NORDIC
Jægersborg Allé 16
P.O. Box 90
DK-2920 Charlottenlund
DENMARK
100442.212@compuserve.com
Tel: 45-39 643 288 / Fax: 645-288

FINLAND
VTT Information Service
P.O. Box 2000
Fin-02044 VTT
FINLAND

(order taking): inf@vtt.fi
Tel: 358-9 456-4430 / Fax: 4374
http://www.vtt.fi/inf/

FRANCE
Books & Research
8, rue Gracieuse
75005 Paris, FRANCE
books&r@transea.fr
Tel: 43-36-33-31 / Fax: 43-36-44-45
http://www.books-and-research.com

World Data
Mr. Boris Prassoloff
10 Rue Nicolas Flamel
75004 Paris, FRANCE
Tel: 33-1 4278-0578 / Fax: -1472

GERMANY
FIZ Karlsruhe
Bibliographic Service/Library
D-76344 Eggenstein-Leopoldshafen,
GERMANY
library@fiz-karlsruhe.de
Tel: 49-7247 808-333 / Fax: 808-135
http://www.fiz-karlsruhe.de

INDIA
Allied Publishers Limited
NTIS Division
751 Mount Road
Madras 600 002, INDIA
Tel: 91-44 8523938 / Fax: -8520649

Higginbothams Ltd.
NTIS Division
814, Anna Salai
Madras 600 002, INDIA
Tel: 91-44 852-1841 / Fax: -8101

INFORMATICS (India) PVT LTD
NTIS Division
No. 337, 3rd Floor, "Karuna Complex"
Sampige Road, Malleswaram
Bangalore 560 003, INDIA
INFO.BNG@IIPL.sprintrpg.sprint.com
Tel: 91-80 367867 / Fax: 91-80 3344598

ISRAEL
Teldan Information Systems Ltd.
Mr. Asher Sofrin, Manager
7 Derech Hashalom
Tel Aviv 67892, ISRAEL
teldan@netvision.net.il
Tel: 972-3 695-0073 / Fax: -6359
http://teldan.com

ITALY
Diffusione Edizioni Anglo-Americane
Librerie Internazionali
Ms. Bianca Ligi
28 Via Lima
00198 Rome, ITALY

deanet@deanet.it
Tel: 39-6 855-1441 / Fax: -3228
http://www.deanet.com

JAPAN
MRI Information Network Inc.
MRI Bldg.
3-6, Otemachi 2-Chome
Chiyoda-Ku, Tokyo 100, JAPAN
LDI03246@niftyserve.or.jp
Tel: 81-3 3277-0794 / Fax: -3486

KOREA
KIITI
Information Resources Dept
P.O. Box 205
Cheongryangri, Seoul, KOREA
Tel: 82-2 962-6211 / Fax: -4702

THE NETHERLANDS
Bibliotheek TU Delft
P.O. Box 98
2600 MG Delft
THE NETHERLANDS
Info@library.tudelft.nl
Tel: 31-15 278-5940 / Fax: -215-9007

SPAIN
INFILE
Don Ramon de la Cruz, 101- 4 B
28006 Madrid, SPAIN
Tel: 34-1-402-3236 / Fax: -4819

SWEDEN
Studsvik Library
Mr. Sten Wesslen
S-611-82 Nykoping, SWEDEN
STUBIB@LIB.KTH.SE
Tel: 46-155 221-000 / Fax: -263-044

TAIWAN
Science & Technology Info Center
National Science Council
14-16F, No. 106,
Ho-Ping East Rd, Sec. 2
Taipei (10636)
TAIWAN, ROC
mei@mailsrv.st.stic.gov.tw
Tel: 886-2 737-7649 / Fax: -7664

UNITED KINGDOM
Microinfo Limited
P.O. Box 3
Omega Park
Alton, Hants GU34 2PG
ENGLAND
ntis@ukminfo.demon.co.uk
Tel: 44-1420-86 848 / Fax: 89-889
www.microinfo.co.uk/

# *DOE-2.1E Documentation for U.S., Canadian and Mexican Users*

DOE-2 documentation is available from two sources.

- The National Technical Information Service offers a complete set of DOE-2 manuals, available for purchase separately; prices and ordering information are below.
- The Energy Science Technology Software Center at Oak Ridge, TN, offers the DOE-2.1E updated documentation (which includes the *Supplement, Sample Run Book,* and *BDL Summary)* free of charge when you purchase the mainframe or workstation version of DOE-2. See the "DOE-2 Directory of Program Related Software and Services" in this issue for ESTSC's address.

Also, many of the PC vendors of DOE-2 offer some or all of the documentation when you buy their program. Names and addresses of all DOE-2 vendors are found in the "DOE-2 Directory Software" in this issue.

**To order DOE-2 manuals from the National Technical Information Service:**
National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161
Phone 1-800-553-6847, FAX (703) 321-8547, http://www.ntis.gov/

| Document Name | Order Number | Price* |
|---|---|---|
| DOE-2 Basics Manual (2.1E) | DE-940-13165 | 49.00 |
| BDL Summary (2.1E) | DE-940-11217 | 28.00 |
| Sample Run Book (2.1E) | DE-940-11216 | 100.00 |
| Reference Manual (2.1A) | LBL-8706, Rev.2 | 174.00 |
| Supplement (2.1E) | DE-940-11218 | 100.00 |
| Engineers Manual (2.1A) [algorithm descriptions] | DE-830-04575 | 57.00 |
| | | *as of 12/01/97 |

| **Subscriptions ¨ Help Desk ¨ DOE-2 Training** | |
|---|---|
| ***Building Energy Simulation User News*** **(a quarterly newsletter)** Sent without charge, the newsletter prints documentation updates and changes, bug fixes, inside tips on using the programs more effectively, and articles of special interest to users of DOE-2, BLAST, SPARK and their derivatives. The winter issue features an index of articles printed in all the back issues. | Simulation Research Group<br>Bldg. 90, Room 3147<br>Lawrence Berkeley National Laboratory<br>Berkeley, CA 94720<br>Contact: Kathy Ellington<br>Fax: (510) 486-4089<br>kathy@srge.lbl.gov |
| **Help Desk: Bruce Birdsall** Call or fax Bruce Birdsall if you have a DOE-2 problem or question. If you need to fax an example of your problem to Bruce, please be sure to telephone him prior to sending the fax. This is a free service provided by the Simulation Research Group at Lawrence Berkeley National Laboratory. | Bruce Birdsall<br>Phone/Fax: (925) 671-6942<br><br>Monday through Friday<br>10 a.m. to 3 p.m. Pacific Time |
| **Training** DOE-2 courses for beginning and advanced users. | Marlin Addison<br>Phone: (602) 968-2040<br>marlin.addison@doe2.com |

## Software Available for Downloading and Testing from LBNL

| *Name of Program* | *Download Site* |
|---|---|
| ***BDA (Building Design Adisor)*** (for building decision-makers) | http://kmp.lbl.gov/bda |
| ***COMIS*** (multizone air flow and contaminant transport model) | http://www-epb.lbl.gov/comis |
| **GenOpt** (generic optimization program) | http://eetd.lbl.gov/btp/simulations/ |
| **RADIANCE** (analysis and visualization of lighting in design.) | http://radsite.lbl.gov/radiance/license.html |
| **RESEM** (Retrofit Energy Savings Estimation Model) calculates long-term energy savings directly from actual utility data, with corrections for weather and use variations between the pre-retrofit and post-retrofit utility data collection periods. | http://eande.lbl.gov/btp/resem.html |
| **SPARK (Simulation Problem Analysis and Research Kernel)** allows you to quickly build simulations of innovative building envelope and HVAC systems by graphically connecting models for envelope components with HVAC components.<br>***WinSPARK*** - Windows Version<br>***VisualSPARK*** - UNIX and PC Versions | email KLEllington@lbl.gov and request downloading instructions |
| ***SUPERLITE*** (calculate illuminance distribution for room geometries) | http://eande.lbl.gov/btp/superlite2.html |
| **THERM** (model two-dimensional heat-transfer effects in building components where thermal bridges are of concern) | http://windows.lbl.gov/software/therm/therm_getacopy.html |
| ***WINDOW-4.1*** (thermal analysis program to characterize window product performance) | http://eande.lbl.gov/software/window/window.html |

**LAWRENCE BERKELEY NATIONAL LABORATORY**
**Simulation Research Group MS: 90-3147**
**University of California**
**Berkeley, CA 94720 U.S.A.**

**ADDRESS CORRECTION REQUESTED**

**First Class**
**U.S. POSTAGE PAID**
**Berkeley, CA**
**Permit No. 1123**

**Reminder!**
**Deadline for submission of articles to the Summer issue of the User News is June 11**